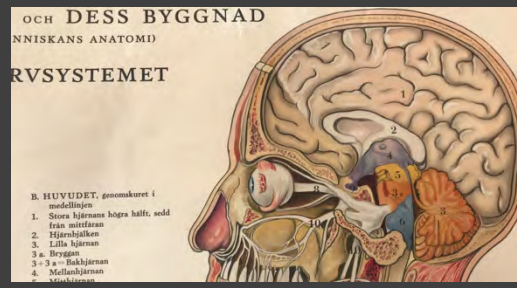
Peering into…
transdisciplinary intersections that impact learner experiences of eHealth multimedia



Anneliese Lilienthal
Karolinska Institutet, Stockholm, Sweden

16 July 2019 | IT & Health Bridging the Gap
eHealth Eurocampus | Barcelona | UPC Campus Nord

Image Credits: Pixabay, Anneliese Lilienthal, home décor, pixabay

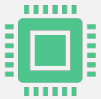
Objective:

To understand the complex multidisciplinary factors possibly impacting attention and engagement in multimedia so that you can begin to discuss and apply…

Outline

Transdisciplinary Activity

Learning Theory



eHealth Media Production (Highlights)

Transdisciplinary Themes for Production

Evaluation

Image Credit: Copyright ©Anneliese Lilienthal

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What are your various roles/disciplines/occupations?

Mentimeter

Digital Artist, Public Health Scholar, Teacher, Innovator, Scientist, Project Manager, Carer	ff	Project manager
Teacher, Project Manager	Project Manager	Scientist
Health	Teacher, Scientist, innovator	Teacher, project manager
Developer, Teacher, Scientist, Manager	Teacher, Innovator	project management
Project Manager	Researcher	Design, journalism, science, communication, health
Biomedical engineering	Public health,teacher	Software Engineering, User interface design, Project Management
faculty researcher	ehealth, robotics, medical robotics	Teacher/biomedical engineering/manager

21

Remember: List, Recognise, Recall, Identify

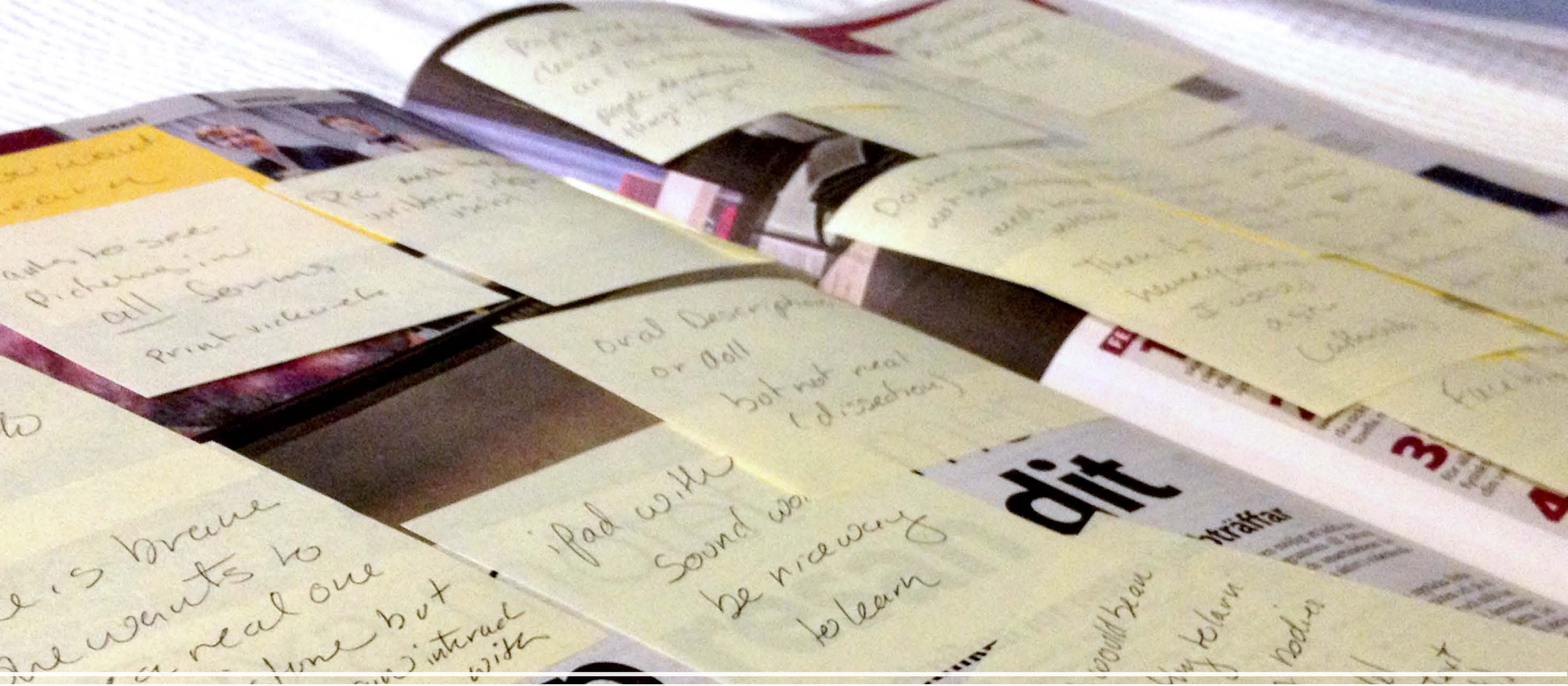
Image Credits: Sustainable Development Goals

Understand: Summarise, Classify, Clarify, Predict

Image Credits: Pu Tai

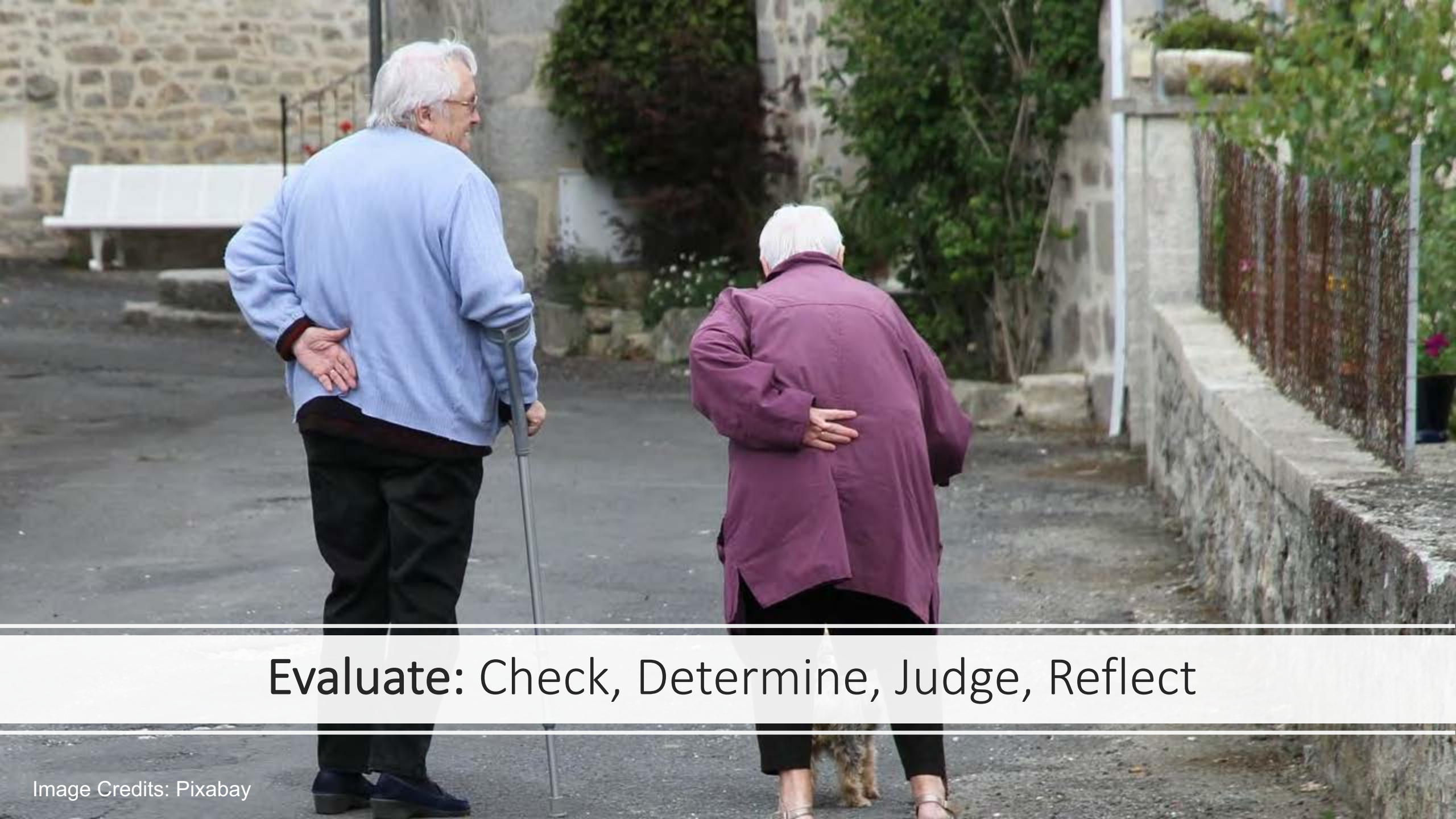
Apply: Respond, Provide, Carry Out, Use

Image Credits: Anneliese Lilienthal, Hanoi Vietnam



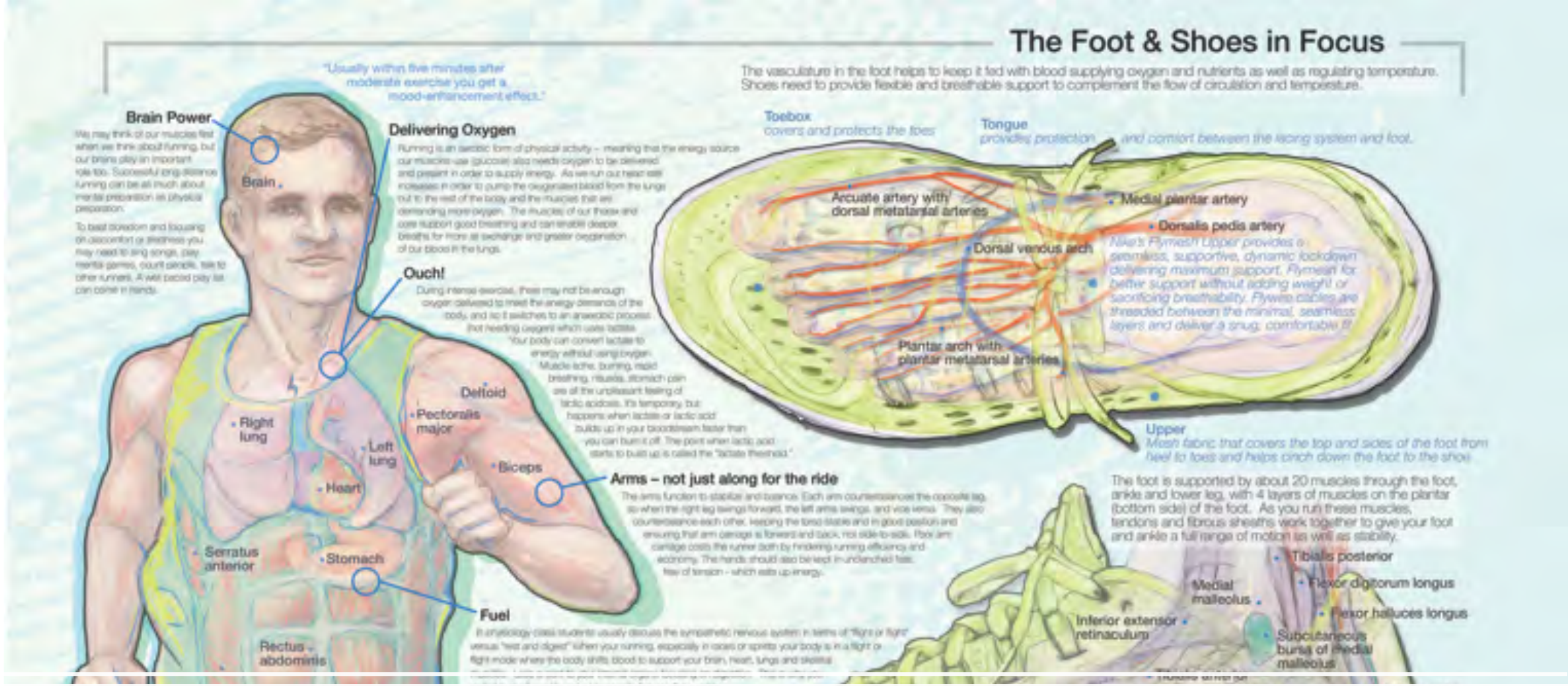
Analyse: Select, Differentiate, Integrate, Deconstruct

Image Credits: Anneliese Lilienthal



Evaluate: Check, Determine, Judge, Reflect

Image Credits: Pixabay


The Foot & Shoes in Focus
"Usually within five minutes after moderate exercise you get a mood-enhancement effect."
The vasculature in the foot helps to keep it fed with blood supplying oxygen and nutrients as well as regulating temperature. Shoes need to provide flexible and breathable support to complement the flow of circulation and temperature.
Brain Power
We may think of our muscles first when we think about running, but our brains play an important role too. Successful long-distance running can be as much about mental preparation as physical preparation.
To beat boredom and loosen discomfort or tiredness you may need to sing songs, play mental games, count people, talk to other runners. A well paced pep talk can come in handy.
Brain
Delivering Oxygen
Running is an aerobic form of physical activity – meaning that the energy source our muscles use (glucose) also needs oxygen to be delivered and present in order to supply energy. As we run our heart rate increases in order to pump the oxygenated blood from the lungs out to the rest of the body and the muscles that are demanding more oxygen. The muscles of our thorax and core support good breathing and can enable deeper breaths for more air exchange and greater oxygenation of our blood in the lungs.
Ouch!
During intense exercise, there may not be enough oxygen delivered to meet the energy demands of the body, and so it switches to an anaerobic process (not needing oxygen) which uses lactate.
Your body can convert lactate to energy without using oxygen.
Muscle ache, burning, rapid breathing, nausea, stomach pain are all the unpleasant feeling of lactic acidosis. It's temporary, but happens when lactate or lactic acid builds up in your bloodstream faster than you can burn it off. The point when lactic acid starts to build up is called the "lactate threshold."
Deltoid
Pectoralis major
Right lung
Left lung
Heart
Biceps
Serratus anterior
Stomach
Rectus abdominis
Arms – not just along for the ride
The arms function to stabilize and balance. Each arm counterbalances the opposite leg, so when the right leg swings forward, the left arms swings, and vice versa. They also counterbalance each other, keeping the torso stable and in good position and ensuring that arm carriage is forward and back, not side-to-side. Poor arm carriage costs the runner both by hindering running efficiency and economy. The hands should also be kept in unclenched fists, free of tension – which eats up energy.
Fuel
In physiology class students usually discuss the sympathetic nervous system in terms of "flight or fight" versus "rest and digest" when your running, especially in races or sprints your body is in a flight or fight mode where the body shifts blood to support your brain, heart, lungs and skeletal
Toebox
covers and protects the toes
Tongue
provides protection and comfort between the lacing system and foot.
Arcuate artery with dorsal metatarsal arteries
Medial plantar artery
Dorsalis pedis artery
Dorsal venous arch
Nike's Flyknit Upper provides a seamless, supportive, dynamic lockdown delivering maximum support. Flyknit for better support without adding weight or sacrificing breathability. Flywire cables are threaded between the minimal, seamless layers and deliver a snug, comfortable fit.
Plantar arch with plantar metatarsal arteries
Upper
Mesh fabric that covers the top and sides of the foot from heel to toes and helps cinch down the foot to the shoe.
The foot is supported by about 20 muscles through the foot, ankle and lower leg, with 4 layers of muscles on the plantar (bottom side) of the foot. As you run these muscles, tendons and fibrous sheaths work together to give your foot and ankle a full range of motion as well as stability.
Tibialis posterior
Flexor digitorum longus
Flexor hallucis longus
Medial malleolus
Inferior extensor retinaculum
Subcutaneous bursa of medial malleolus
Core Stability
During both the swing and stance phases of running the core provides stability for the upper body, which allows the pelvis to twist and rotate in its normal
Adductor longus

Create: Generate, Assemble, Design, Create

Image Credits: Anneliese Lilienthal

eHealth Media Production (Simplified)

User

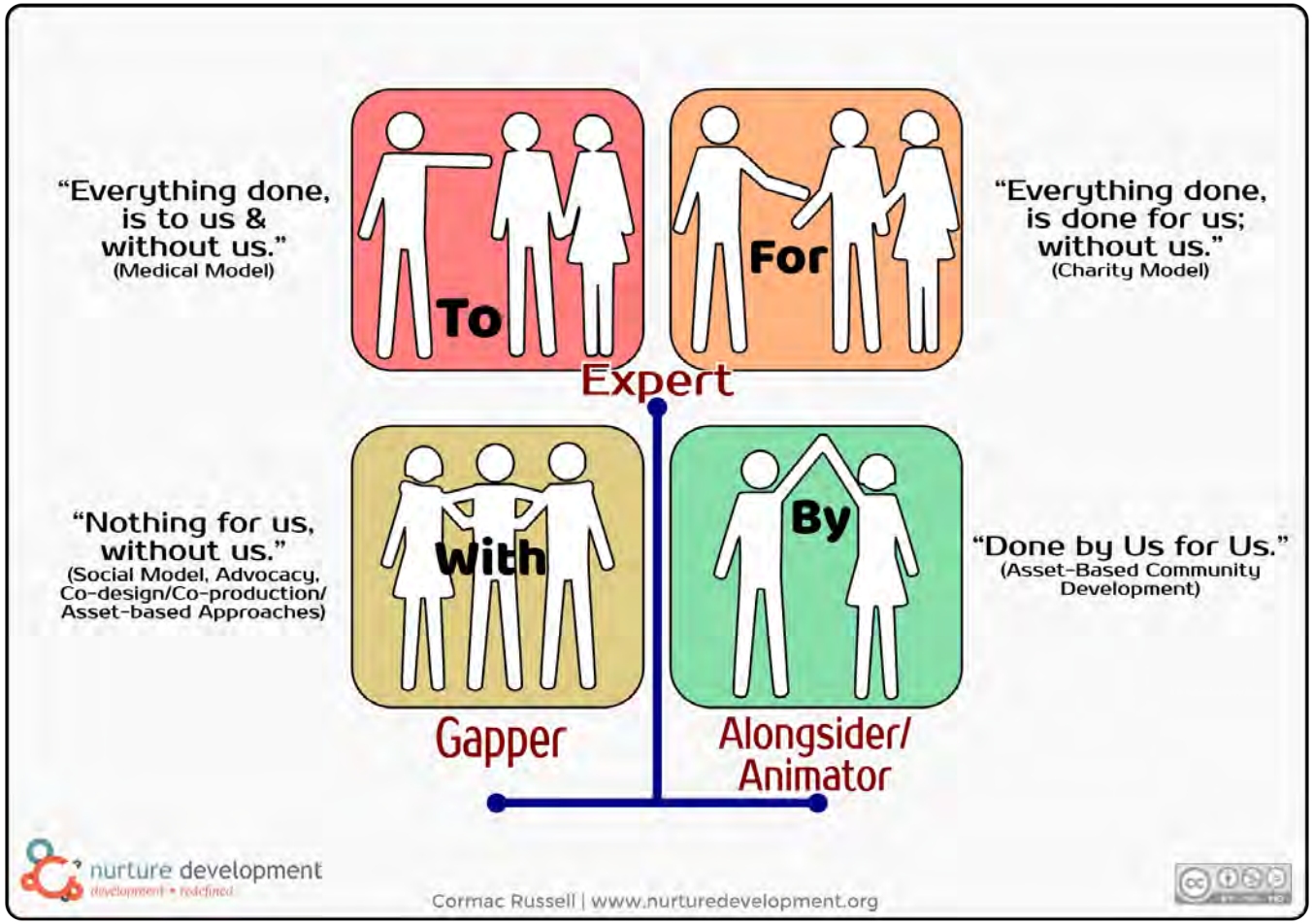
Goal

Mapping / Storyboarding of Activities

Development & Iteration

Evaluation

User



https://www.nurturedevelopment.org/blog/abcd-approach/bridging-the-gap-expert-to-alongsider/

Context

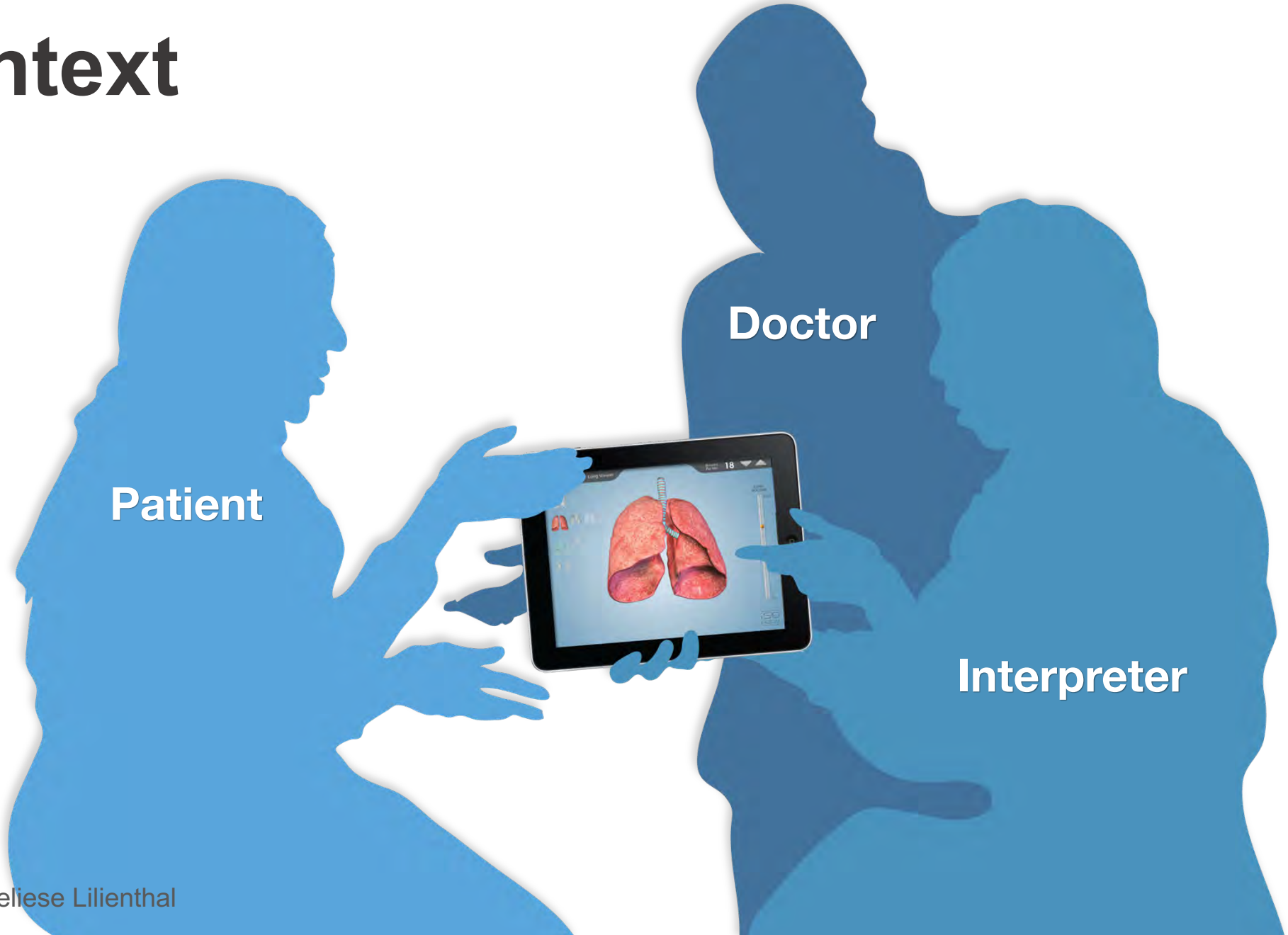


Image Credits: Anneliese Lilienthal

Disadvantaged Groups

- Language / Culture
- Color blindness (5% of men) – Use of contrast (Black to White)

http://www.color-blindness.com/coblis-color-blindness-simulator/

Goal

A statement of a **learning objective** contains a **verb** (an action) and an **object** (usually a noun).

- The **verb** generally refers to [actions associated with] the intended **cognitive process**.
- The **object** generally describes the **knowledge** students are expected to acquire or construct. (Anderson and Krathwohl, 2001, pp. 4–5)

In this model, each of the colored blocks shows an example of a learning objective that generally corresponds with each of the various combinations of the cognitive process and knowledge dimensions.

Remember: these are **learning *objectives***—not learning *activities*. It may be useful to think of preceding each objective with something like: "Students will be able to . . ."

*Anderson, L.W. (Ed.), Krathwohl, D.R. (Ed.), Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J., & Wittrock, M.C. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of Educational Objectives* (Complete edition). New York: Longman.

Model created by: Rex Heer
Iowa State University
Center for Excellence in Learning and Teaching
Updated January, 2012
Licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License.
For additional resources, see:
www.celt.iastate.edu/teaching/RevisedBlooms1.html

IOWA STATE UNIVERSITY
Center for Excellence in Learning and Teaching

http://www.celt.iastate.edu/wp-content/uploads/2015/09/RevisedBloomsHandout-1.pdf

GAME MECHANICS	THINKING SKILLS	LEARNING MECHANICS	
○ Design/Editing ○ Infinite Game play ○ Ownership ○ Protégé Effect ○ Status ○ Strategy/Planning ○ Tiles/Grids	CREATING	○ Accountability ○ Ownership ○ Planning ○ Responsibility	
○ Action Points ○ Assessment ○ Collaboration ○ Communal Discovery ○ Resource Management ○ Game Turns ○ Pareto Optimal ○ Rewards/Penalties ○ Urgent Optimism	EVALUATING	○ Assessment ○ Collaboration ○ Hypothesis ○ Incentive ○ Motivation ○ Reflect/Discuss	
○ Feedback ○ Meta-game ○ Realism	ANALYSING	○ Analyse ○ Experimentation ○ Feedback ○ Identify ○ Observation ○ Shadowing	
○ Capture/Elimination ○ Competition ○ Cooperation ○ Movement ○ Progression ○ Selecting/Collecting ○ Simulate/Response ○ Time Pressure	APPLYING	○ Action/Task ○ Competition ○ Cooperation ○ Demonstration ○ Imitation ○ Simulation	
○ Appointment ○ Cascading Information ○ Questions And Answers ○ Role-play ○ Tutorial	UNDERSTANDING	○ Objectify ○ Participation ○ Question And Answers ○ Tutorial	
○ Cut scenes/Story ○ Tokens ○ Virality ○ Behavioural Momentum ○ Pavlovian Interactions ○ Goods/Information	RETENTION	○ Discover ○ Explore ○ Generalisation ○ Guidance ○ Instruction ○ Repetition	

LOTS to HOTS

Figure 3. Classifications based on Bloom's ORDERED Thinking Skills

Arnab, S. 2015.
Mapping Learning and Game Mechanics for Serious Games and Analysis

XVIVO scientific animation

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Our DNA | About | Team | Clients | Project Inquiry | Contact Us
Xtra | Blog | Testimonials | Wallpapers

SEARCH

Work / Interactive / Touch Screen Esther The Digester Connecticut Science Center

INTERACTIVE

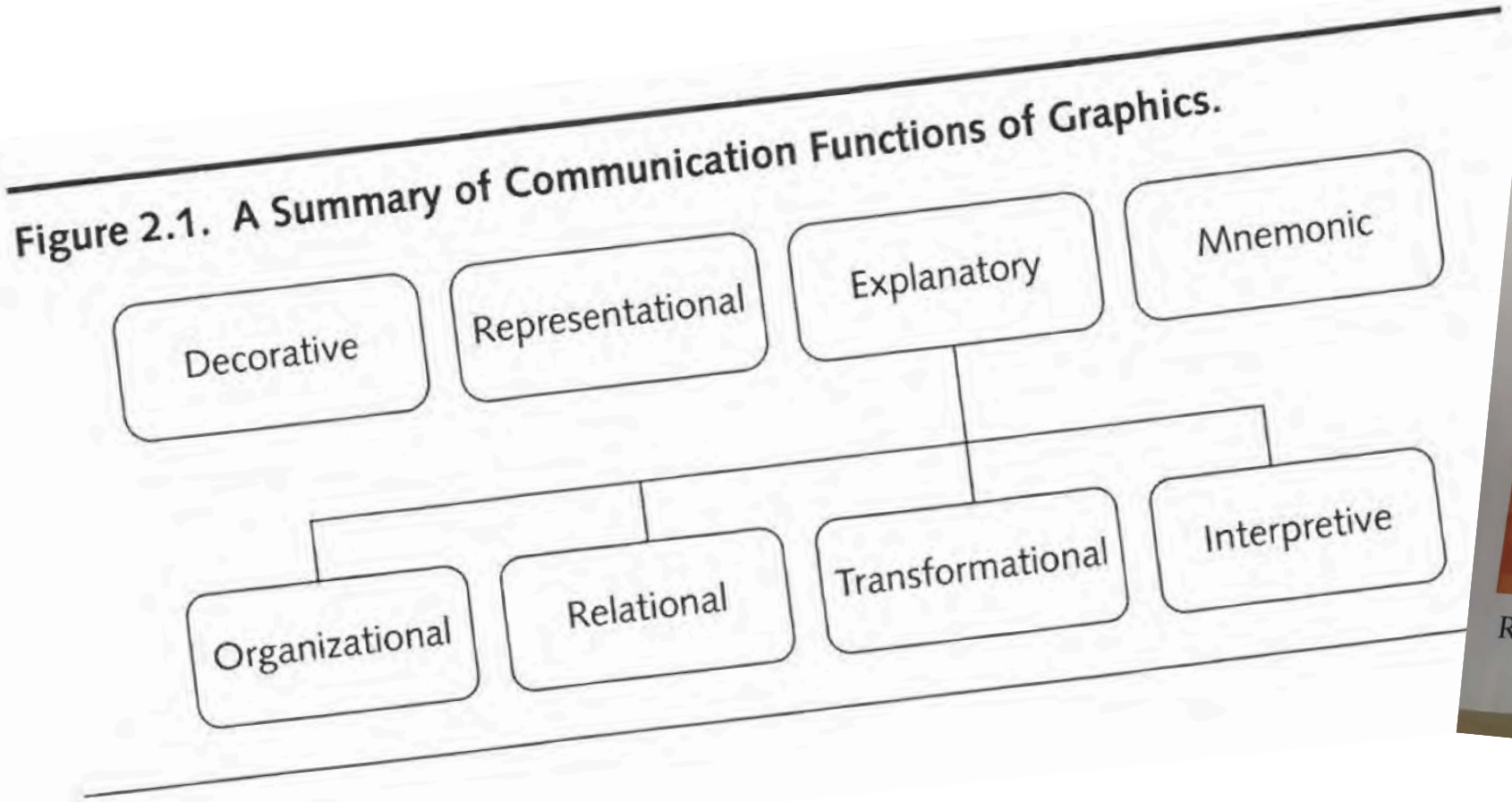
TOUCH SCREEN ESTHER THE DIGESTER CONNECTICUT SCIENCE CENTER

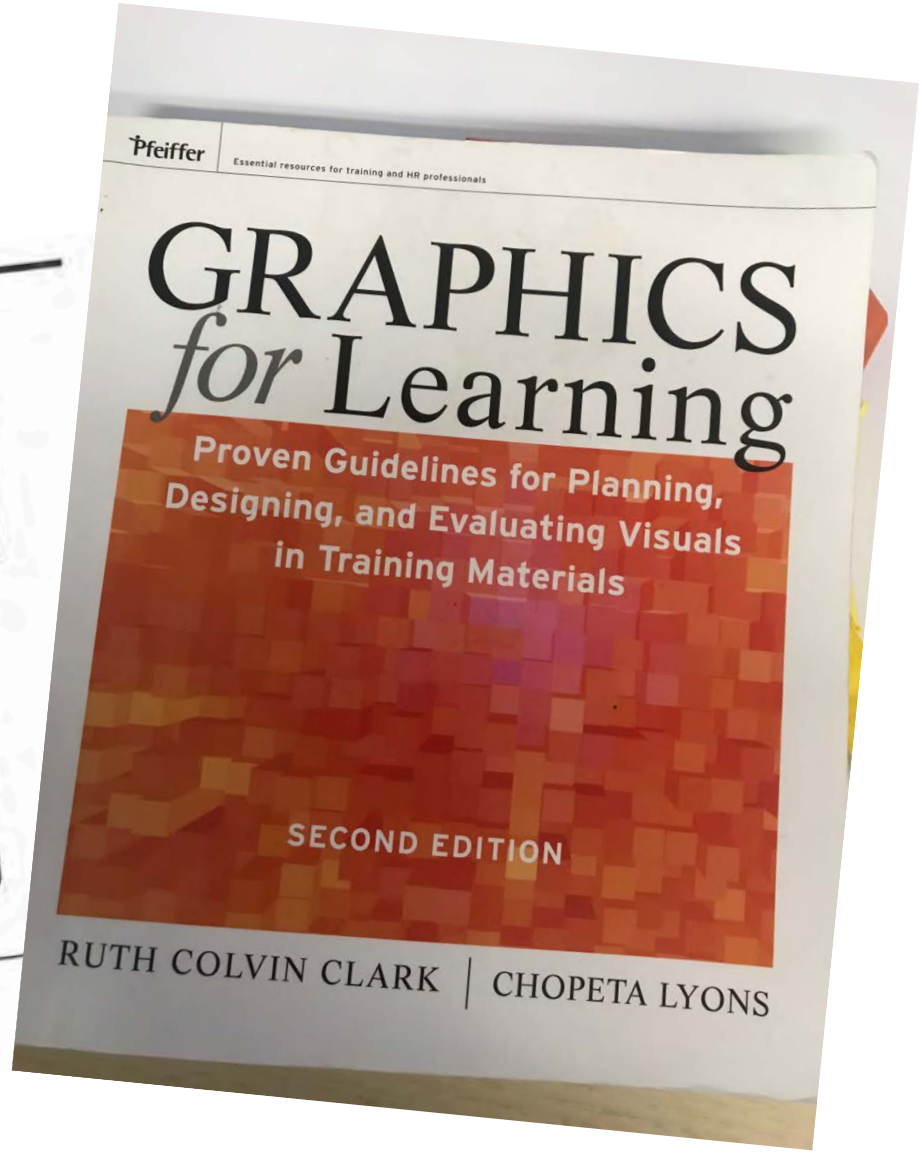
Boston Productions Inc. teamed up with XVIVO to design an interactive exhibit at Connecticut's new Science Center. This game gives visitors an opportunity to explore how the different types of food can effect health and well being. Interactive feedback shows how, over time, the effects of exercise and diet choices can influence diseases such as diabetes and obesity.

Esther the digester

https://www.xvivo.net/interactive/esther-the-digester/

Roles of Visuals




Pfeiffer
Essential resources for training and HR professionals
GRAPHICS for Learning
Proven Guidelines for Planning, Designing, and Evaluating Visuals in Training Materials
SECOND EDITION
RUTH COLVIN CLARK | CHOPETA LYONS

Clark, R. Lyons, C. Graphics for Learning: Proven Guidelines for Planning, Designing, and Evaluating Visuals in Training Materials 2nd Edition. 2010. ISBN-13: 978-0470547441

Roles of Visuals

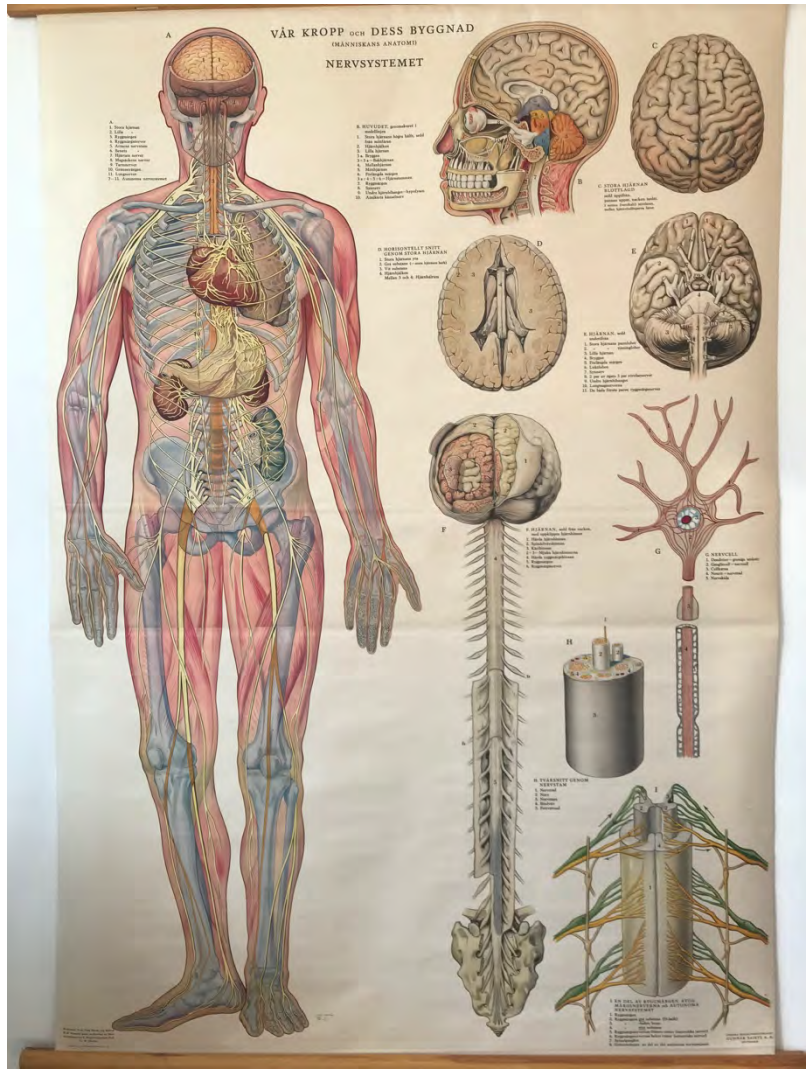
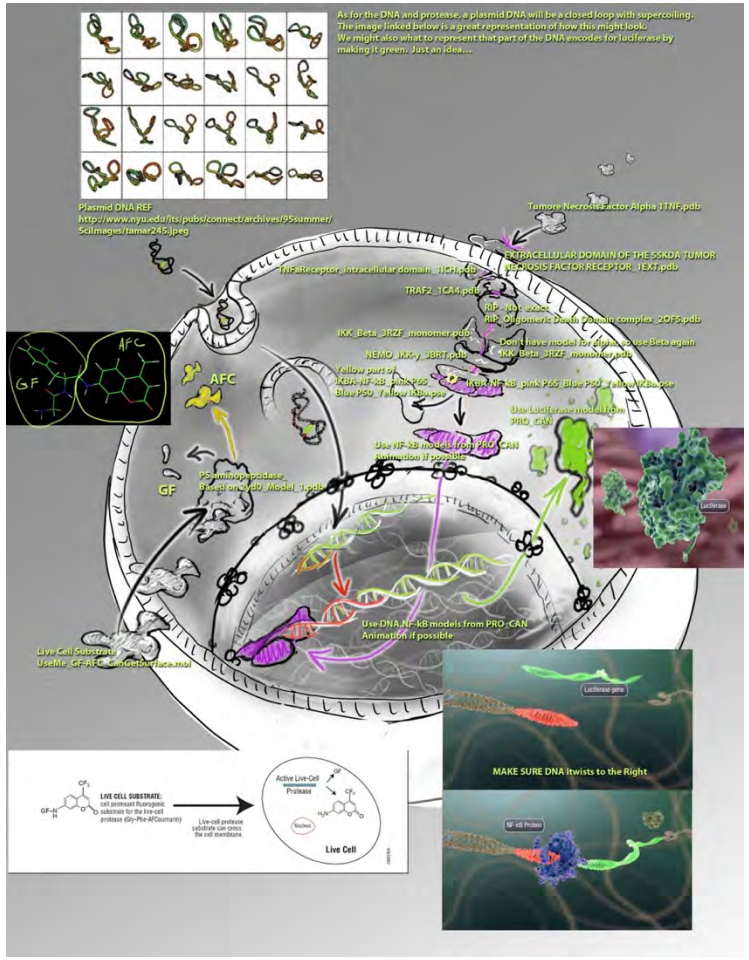


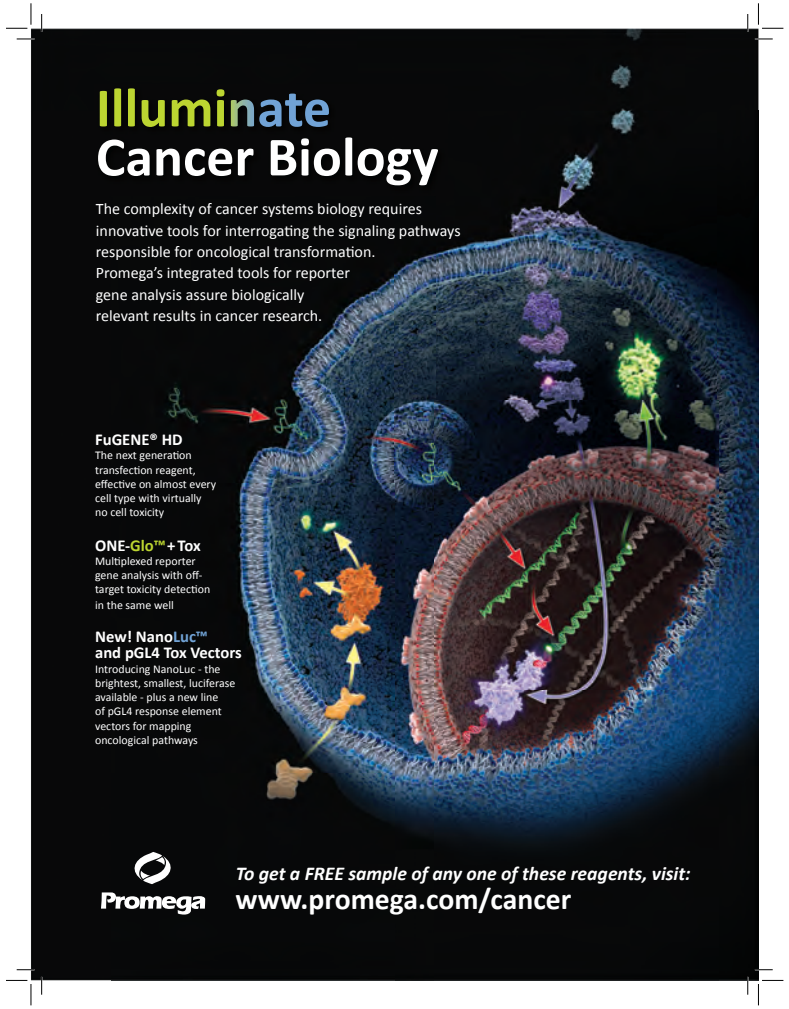
Image Credits: Home Décor, Clark & Lyons, Graphics for Learning

Table 1.3. Communication Functions of Graphics

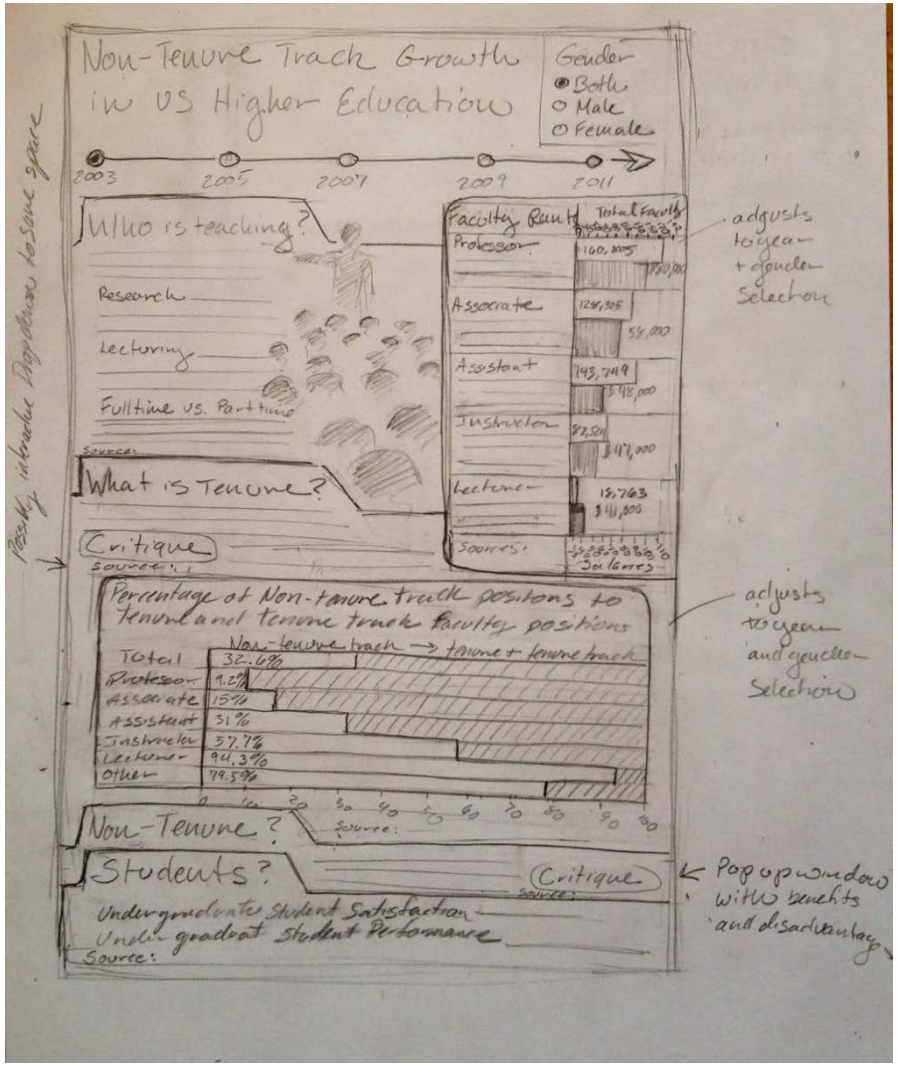
Function	A Graphic Used to	Examples
Decorative	Add aesthetic appeal or humor	Art on the cover of a book Visual of a general in a military lesson on ammunition
Representational	Depict an object in a realistic fashion	A screen capture of a software screen A photograph of equipment
Mnemonic	Provide retrieval cues for factual information	A picture of a stamped letter in a shopping cart to recall the meaning of the Spanish word, Carta (letter)
Organizational	Show qualitative relationships among content	A two-dimensional course map A concept tree
Relational	Show quantitative relationships among two or more variables	A line graph A pie chart
Transformational	Show changes in objects over time or space	An animation of the weather cycle A video showing how to operate equipment
Interpretive	Illustrate a theory, principle, or cause-and-effect relationships	A schematic diagram of equipment An animation of molecular movement

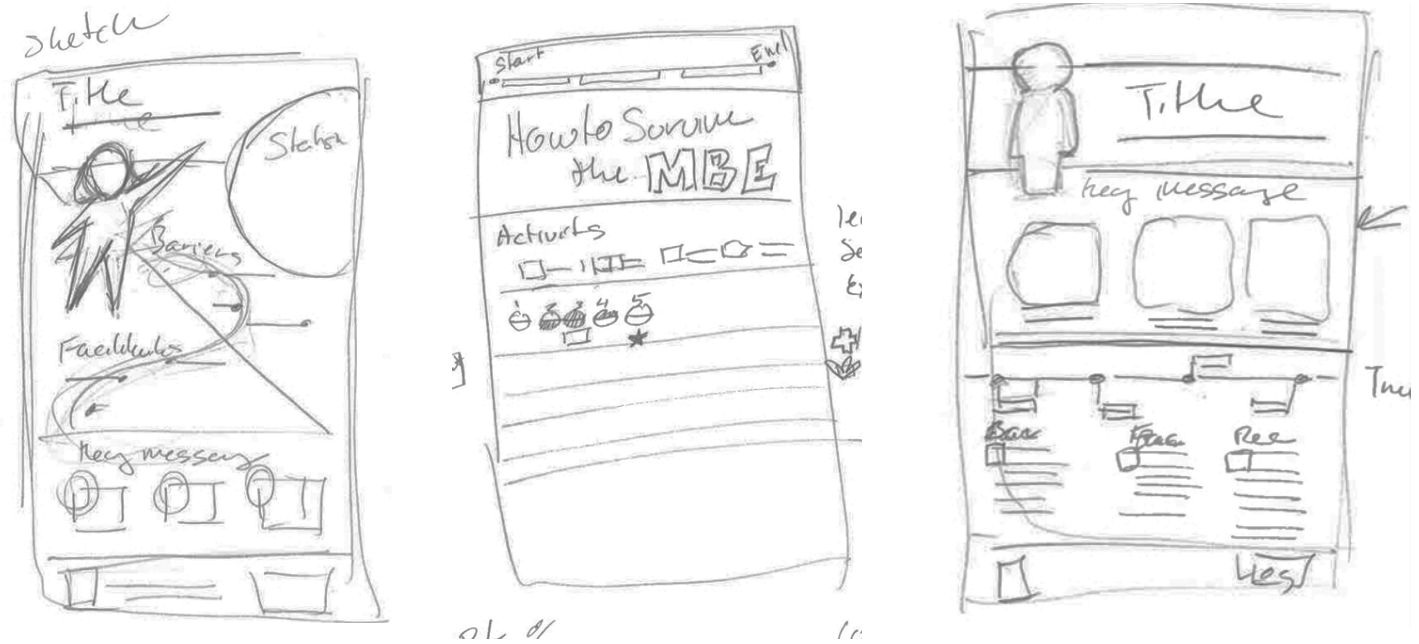
Mapping/Storyboarding of Activities


As for the DNA and protease, a plasmid DNA will be a closed loop with supercoiling. The image linked below is a great representation of how this might look. We might also what to represent that part of the DNA encodes for luciferase by making it green. Just an idea...
Plasmid DNA REF http://www.nyu.edu/its/pubs/connect/archives/95summer/Scimages/tama245.jpeg
Tumore Necrosis Factor Alpha 1TNF.pdb
EXTRACELLULAR DOMAIN OF THE 55KDA TUMOR NECROSIS FACTOR RECEPTOR_1EXT.pdb
TNFaReceptor_intracellular domain_ IICH.pdb
TRAF2_1CA4.pdb
RIP_ Not exact
RIP_Oligomeric Death Domain complex_2OF5.pdb
IKK_Beta_3RZF_monomer.pdb
NEMO_IKK-γ_3BRT.pdb
Don't have model for alpha so use Beta again
IKK-Beta_3RZF_monomer.pdb
Yellow part of IKBA-NF-KB_pink P65 Blue P50_Yellow IKBA.pse
IKBA-NF-KB_pink P65_Blue P50_Yellow IKBa.pse
Use Luciferase model from PRO_CAN
Use NF-KB models from PRO_CAN animation if possible
PSaminopeptidase Based on 2ya0_Model_1.pdb
Use DNA NF-kB models from PRO_CAN Animation if possible
Live Cell Substrate Use Me_GF-AFC_CancerSurface.mol
MAKE SURE DNA itwists to the Right
LIVE CELL SUBSTRATE:
Active Live-Cell Protease
Live Cell
GF
AFC


Illuminate
Cancer Biology
The complexity of cancer systems biology requires innovative tools for interrogating the signaling pathways responsible for oncological transformation. Promega's integrated tools for reporter gene analysis assure biologically relevant results in cancer research.
FuGENE® HD
The next generation transfection reagent, effective on almost every cell type with virtually no cell toxicity
ONE-Glo™ + Tox
Multiplexed reporter gene analysis with off-target toxicity detection in the same well
New! NanoLuc™ and pGL4 Tox Vectors
Introducing NanoLuc - the brightest, smallest, luciferase available - plus a new line of pGL4 response element vectors for mapping oncological pathways
Promega
To get a FREE sample of any one of these reagents, visit:
www.promega.com/cancer

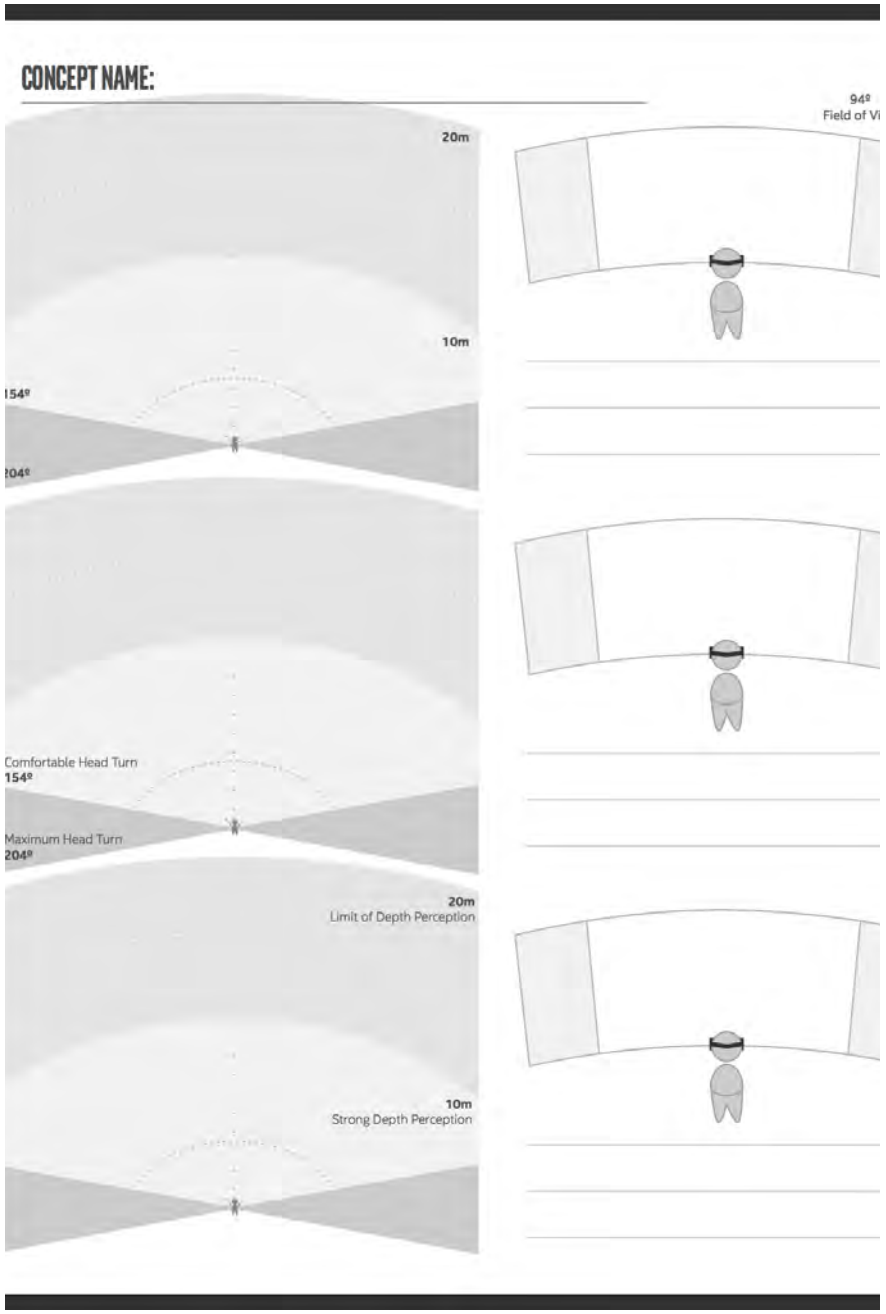
Images XVIVO Scientific Animation for Promega

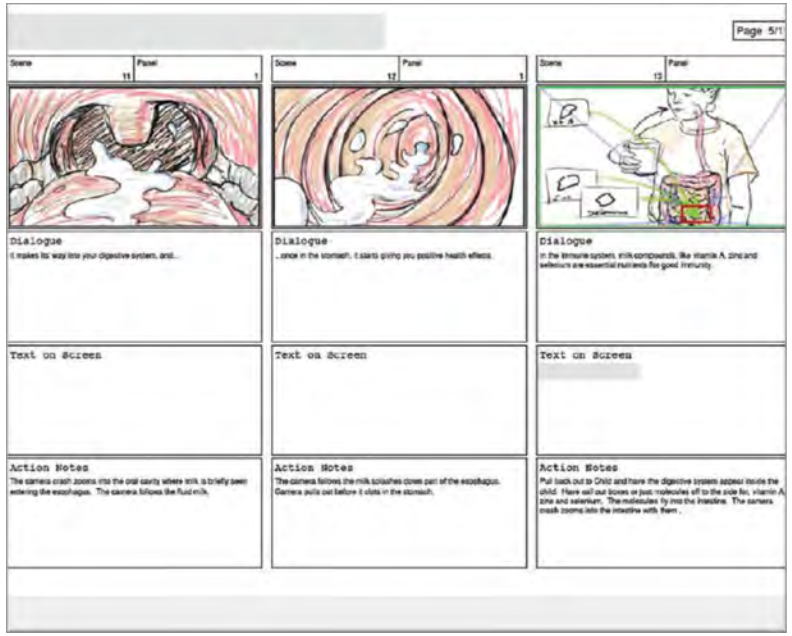




Mapping/Storyboarding

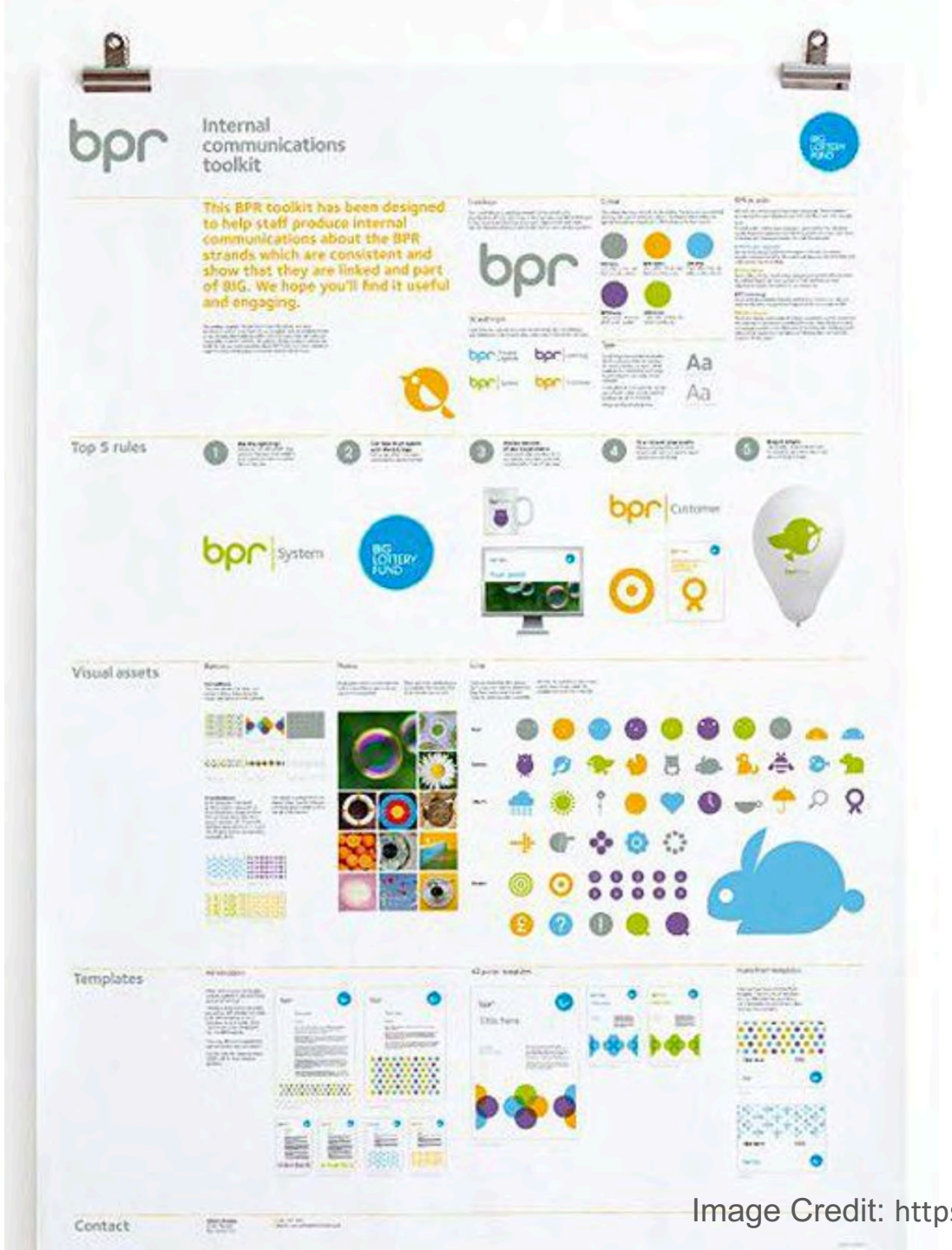
Image Credits: Anneliese Lilienthal





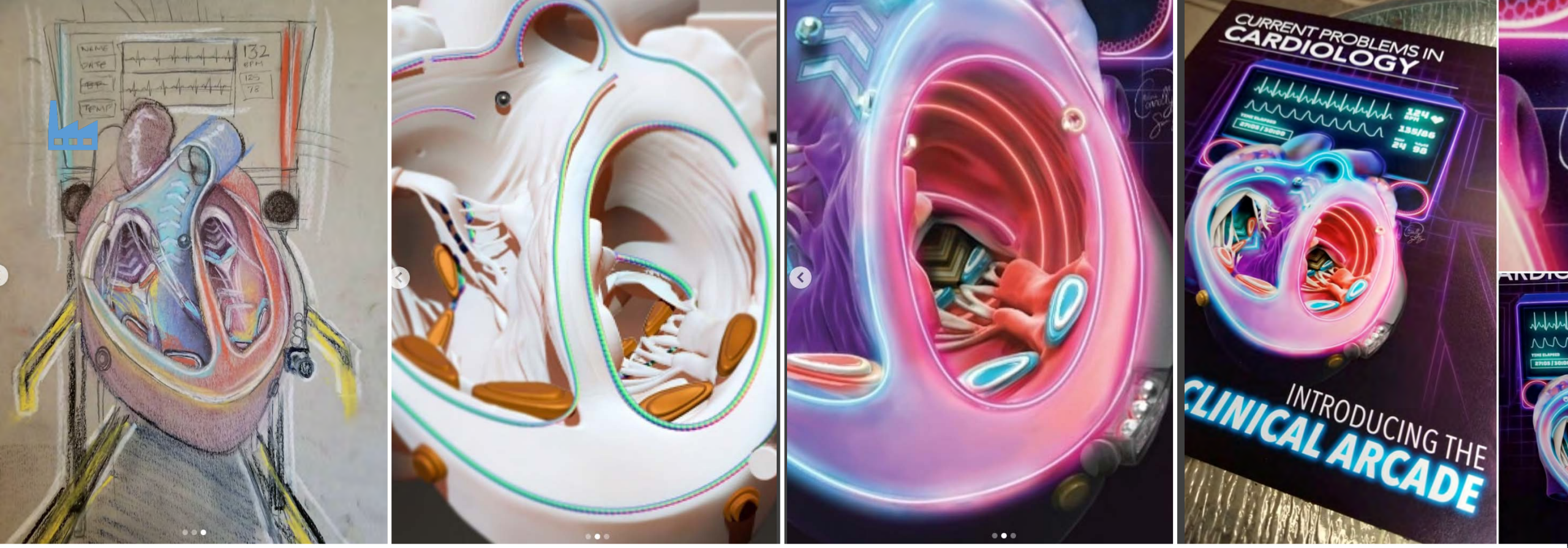
Mapping/Storyboarding

Image Credits: https://blog.prototypr.io/vr-sketch-sheets-4843fd690c91, Anneliese Lilienthal,


bpr
Internal communications toolkit
This BPR toolkit has been designed to help staff produce internal communications about the BPR strands which are consistent and show that they are linked and part of BIG. We hope you'll find it useful and engaging.
Top 5 rules
Visual assets
Templates
Contact

Sample from ”50 meticulous style guides every startup should see before launching” on canva.com

Image Credit: https://www.canva.com/learn/50-meticulous-style-guides-every-startup-see-launching



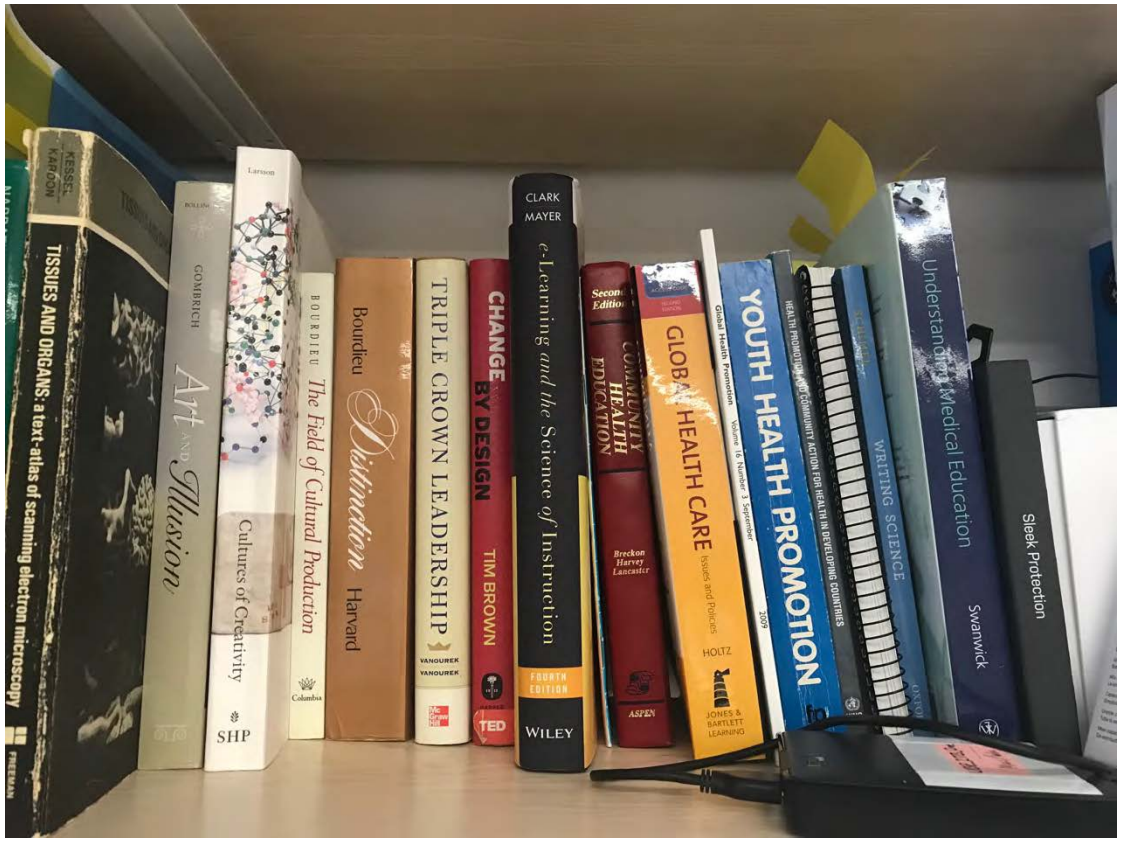
Development & Iteration

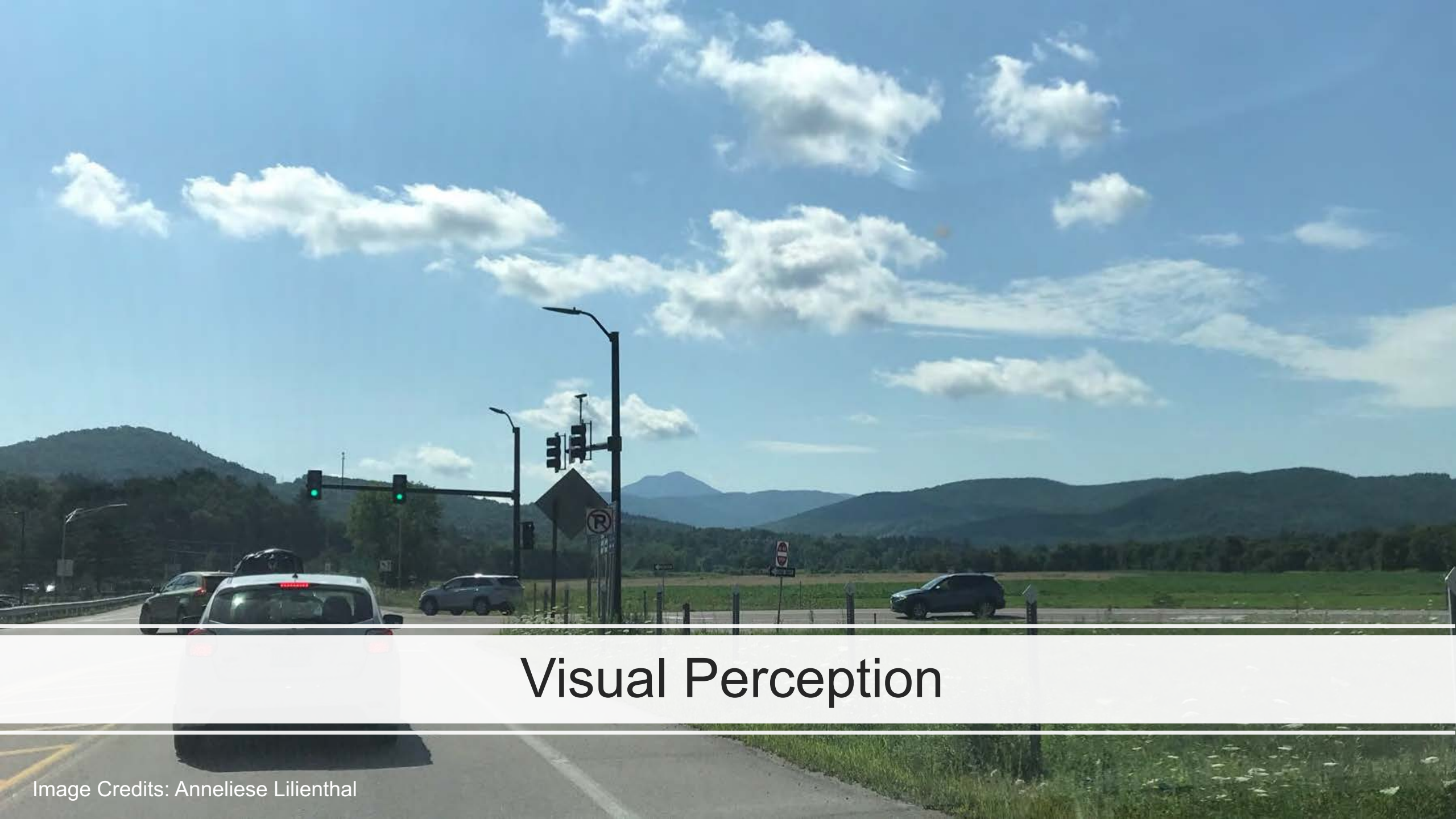
Image Credits: Sam Bond & Melanie Connolly for Meco Visuals

Interdisciplinary Themes for Production

- Visual Perception
- Attention & Cognitive Load
- Aesthetics
- Matrix
- Fidelity & Trust
- Frustration
- Reward

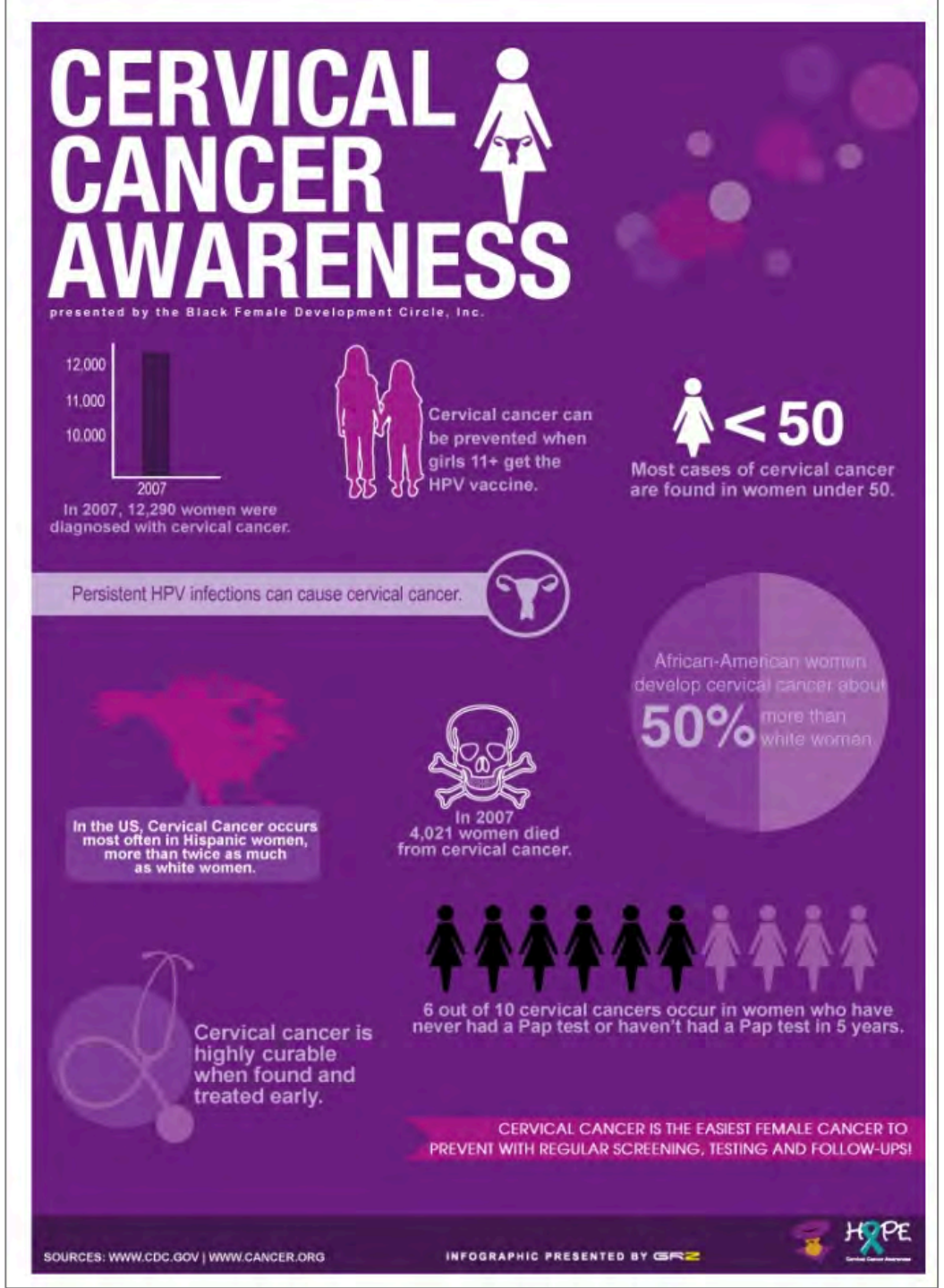
Some of the books on my bookshelves..



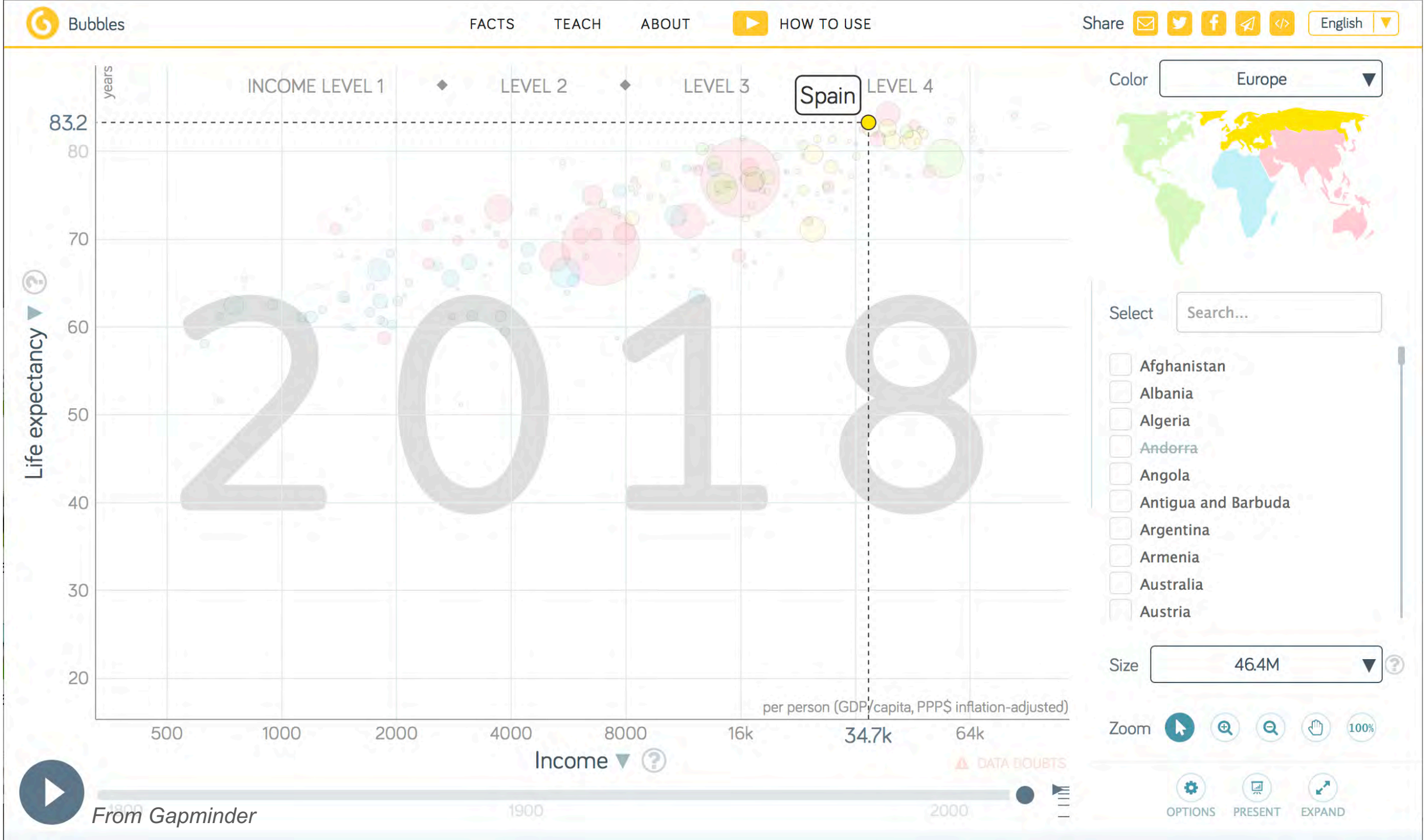


Visual Perception

Image Credits: Anneliese Lilienthal


CERVICAL CANCER AWARENESS
presented by the Black Female Development Circle, Inc.
12,000
11,000
10,000
2007
In 2007, 12,290 women were diagnosed with cervical cancer.
Cervical cancer can be prevented when girls 11+ get the HPV vaccine.
<50
Most cases of cervical cancer are found in women under 50.
Persistent HPV infections can cause cervical cancer.
African-American women develop cervical cancer about 50% more than white women.
In the US, Cervical Cancer occurs most often in Hispanic women, more than twice as much as white women.
In 2007 4,021 women died from cervical cancer.
6 out of 10 cervical cancers occur in women who have never had a Pap test or haven't had a Pap test in 5 years.
Cervical cancer is highly curable when found and treated early.
CERVICAL CANCER IS THE EASIEST FEMALE CANCER TO PREVENT WITH REGULAR SCREENING, TESTING AND FOLLOW-UPS!
SOURCES: WWW.CDC.GOV | WWW.CANCER.ORG
INFOGRAPHIC PRESENTED BY GR2
HOPE

Sample Infographic discussed

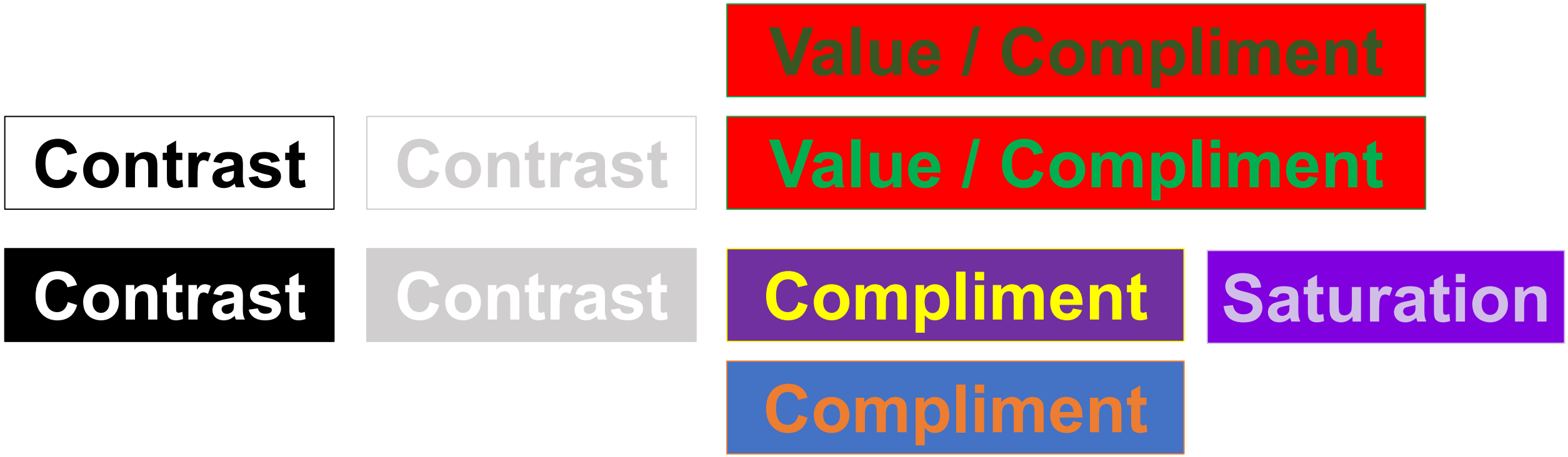

Bubbles
FACTS
TEACH
ABOUT
HOW TO USE
Share
English
years
INCOME LEVEL 1
LEVEL 2
LEVEL 3
LEVEL 4
Spain
83.2
80
70
60
50
40
30
20
Life expectancy
2018
per person (GDP/capita, PPP$ inflation-adjusted)
500
1000
2000
4000
8000
16k
34.7k
64k
Income
DATA DOUBTS
1900
2000
From Gapminder
Color
Europe
Select
Search...
Afghanistan
Albania
Algeria
Andorra
Angola
Antigua and Barbuda
Argentina
Armenia
Australia
Austria
Size
46.4M
Zoom
100%
OPTIONS
PRESENT
EXPAND

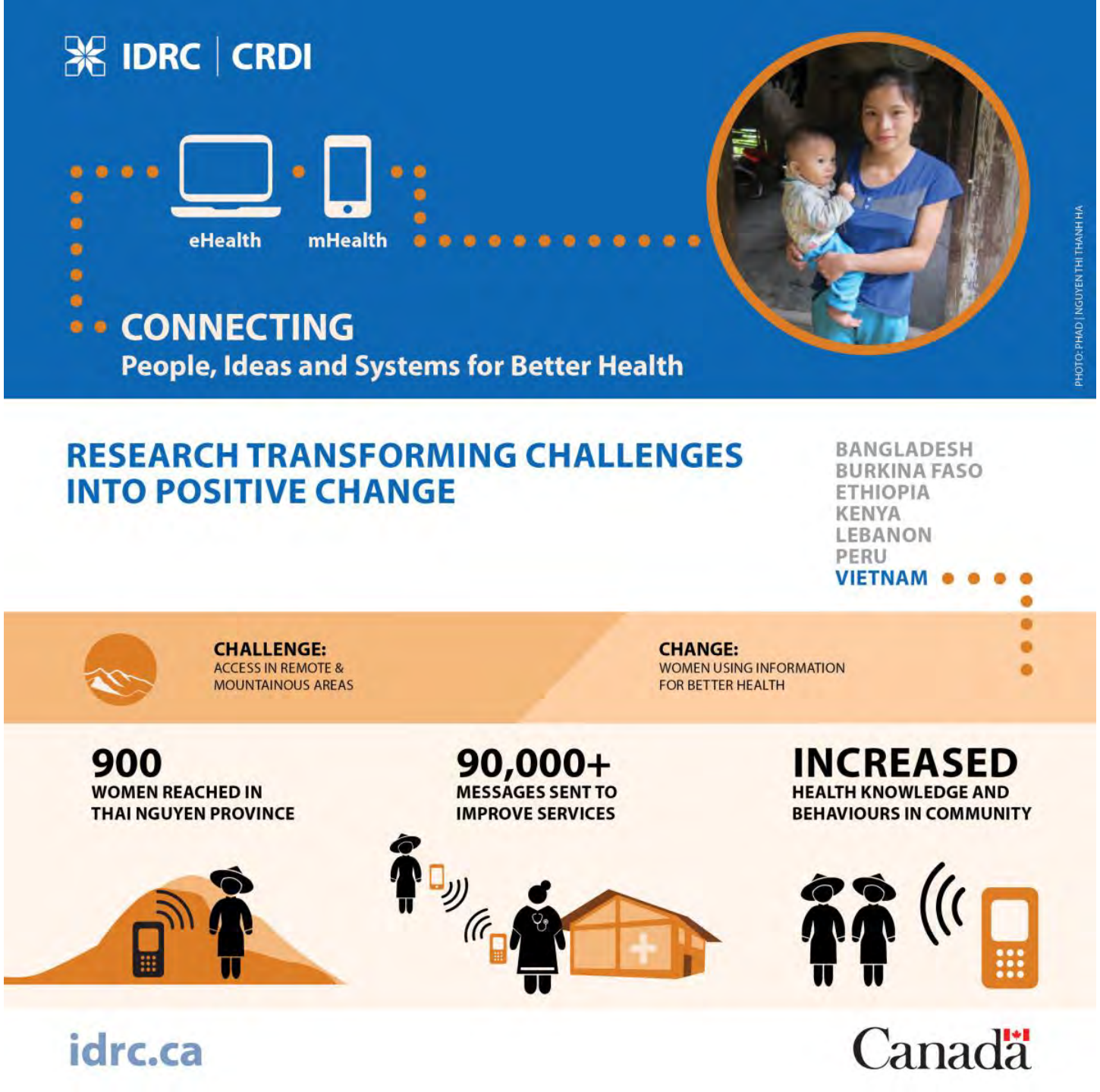
Type

- Type faces
  - Arial
  - Verdana
  - Tahoma
  - (serif font Times New Roman)
- ALL CAPS
- *Italics*
- **Bold**

Yellow on blue

- Do you like?


Value / Compliment
Contrast
Contrast
Value / Compliment
Contrast
Contrast
Compliment
Saturation
Compliment



Sample Infographic discussed

COMPOSITION

NAME_____ PER._____

The art of organizing elements of artwork into a harmonious and pleasing whole.
The consideration of how objects are placed in a design or work of art.

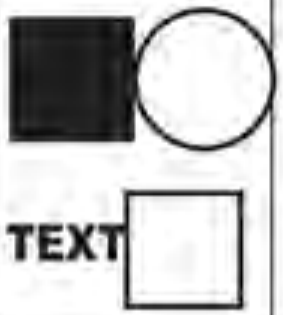
Tips for creating good composition:

1. Overlap

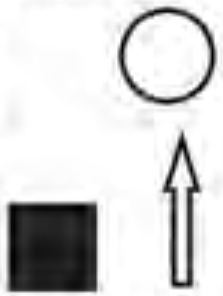
Place objects slightly over one another. This will get the eye to move from one element to another. Objects should not be touching each other by edges ("no kissing allowed!"). Avoid isolation. Build a relationship between objects.

Good overlapping

Avoid kissing



Avoid isolation

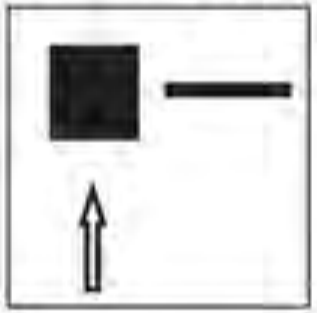


2. Crop

Consider having objects go off the edge of the page. This gets the viewer in and out of the picture. Avoid floating objects within the edges of the page.

Have object go off the page

Avoid floating objects



3. Rotate:

Consider placing objects at an angle. Things that are tilted create a more dynamic composition. Artwork with objects that are perfectly lined up with the edge can be boring.

Tilt objects

Avoid all objects upright

https://lifeartschool.co.za/good-composition-tips/

The State of Public Attitudes to Science

Enthusiasm for science

BENEFITS & HARM

The benefits of science are greater than any harmful effects (agree)

55% [1988 45%]

SPEED OF CHANGE

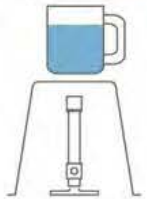
Science makes our way of life change too fast (agree)

34% [1988 49%]

SCIENCE IN DAILY LIFE

It is important to know about science in my daily life (agree)

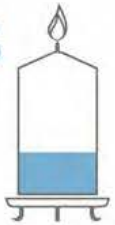
72% [1988 57%]



SCIENCE & FAITH

We depend too much on science and not enough on faith

30% [1988 44%]



Science and the economy

IMPORTANCE OF SCIENCE INTEREST

91% [16-24yrs 84%]

Young people's interest in science is essential for our future prosperity (agree)

SCIENCE & THE INTERNATIONAL STAGE

81% [16-24yrs 71%]

The UK needs to develop its science and technology sector in order to enhance its international competitiveness (agree)

SCIENCE & GROWTH

76% [16-24yrs 73%]

Scientific research makes a direct contribution to economic growth in the UK (agree)

SCIENCE & OPPORTUNITY

62% [16-24yrs 63%]

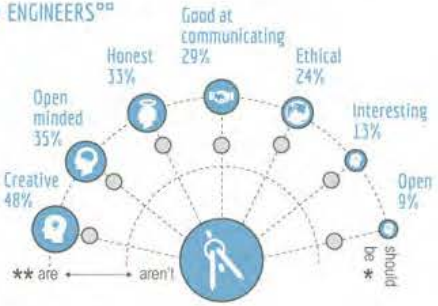
Because of science and technology, there will be more work opportunities for the next generation (agree)

Expectations of scientists and engineers

SCIENTISTS°

See notes for question wording and base size information

ENGINEERS°°



Understanding of how scientists work

ADJUSTING THEIR FINDINGS

Scientists adjust their findings to get the answers they want

35% [agree] **34%** [disagree]

ETHICS

68%

I would like scientists to spend more time discussing the social and ethical implications of their work with the general public (agree)

INFORMATION

58%

Scientists put too little effort into informing the public about their work (agree)

REWARDS

53%

Scientists should be rewarded for communicating their research to the public (agree)

Engagement with Science

Public awareness

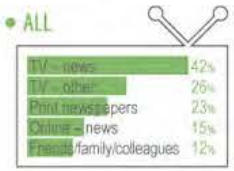
How well informed do you feel, if at all, about science, and scientific research and developments? (very/fairly well informed)

45% [all]

51% [16-24yrs]

Finding out about scientific research

ALL



16-24yrs

From which one or two of these, if any, do you hear or read about new scientific research findings most often?

Trust in science journalism

RELIABILITY

Journalists check the reliability of scientific research findings before they write about them

28% [mostly/always true]

QUALIFICATIONS

Journalists who write stories about science have a science degree or similar qualification

16% [mostly/always true]

Public involvement

NEW TECHNOLOGY

71% [2005 74%]

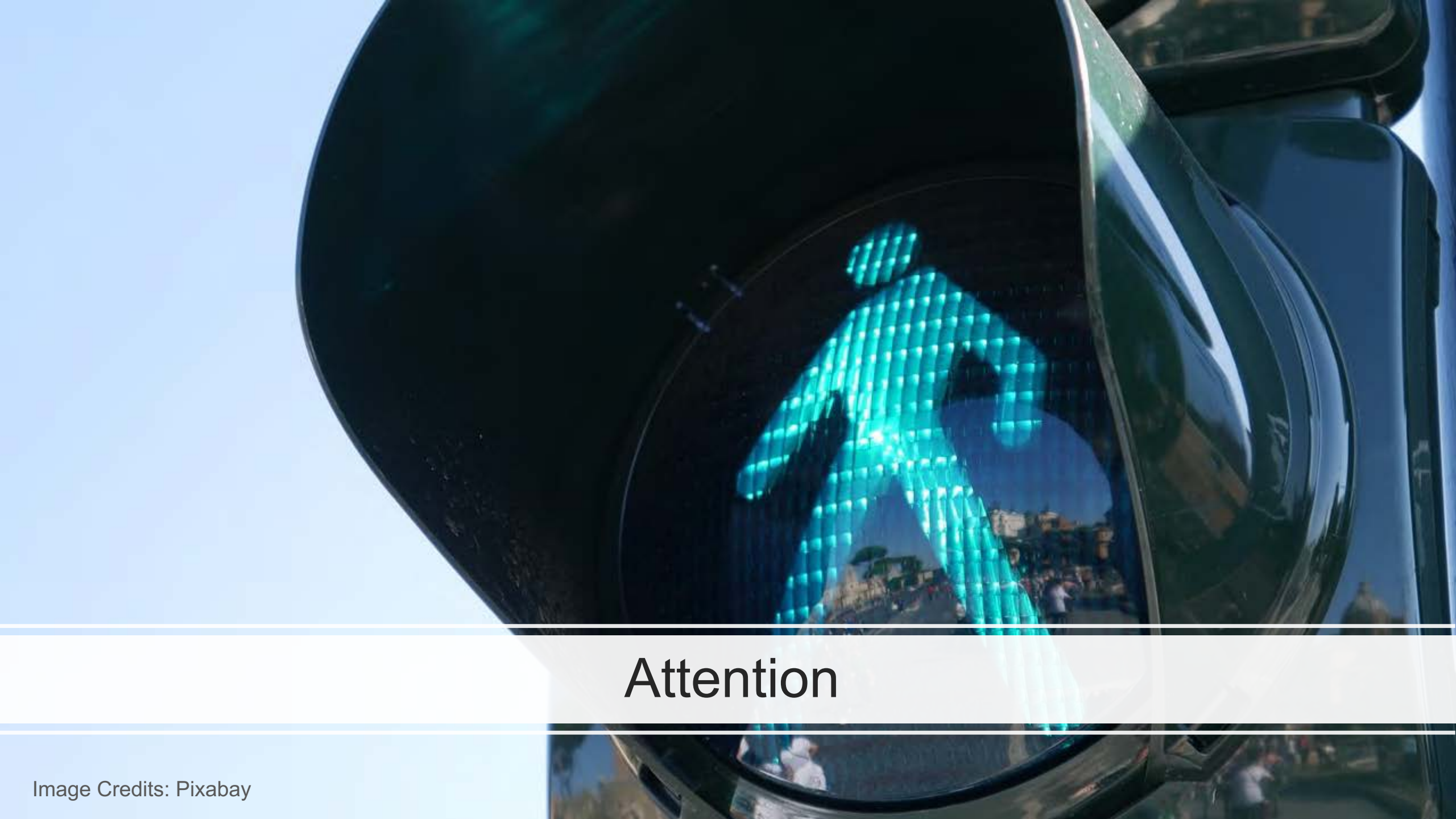
We ought to hear about potential new areas of science and technology before they happen, not afterwards (agree)

DECISION MAKING

43%

I would like to know that the public are involved in decision-making about science issues, but I don't want to be involved personally

Sample Infographic discussed



Attention

Image Credits: Pixabay

Health

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Scientific American Volume 310, Issue 6

Your Intestines Can Taste Sugar: And a New Diabetes Drug Targets Those Sweet Receptors

What good are sweet receptors in the intestines?

June 16, 2014 |

Scientific American Volume 310, Issue 6

A Surveillance Network We Could Learn to Love

June 13, 2014 |

Scientific American Volume 310, Issue 6

Coming Soon: New Machines That Know Exactly What's Bugging You

June 9, 2014 |

Scientific American Volume 310, Issue 6

Take This Tea and Call Me in the Morning [Slide Show]

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60-Second Health PODCAST

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Tornado Injures Nine, One Critically, in North Dakota

"Impossible" Electric Airplane Takes Flight

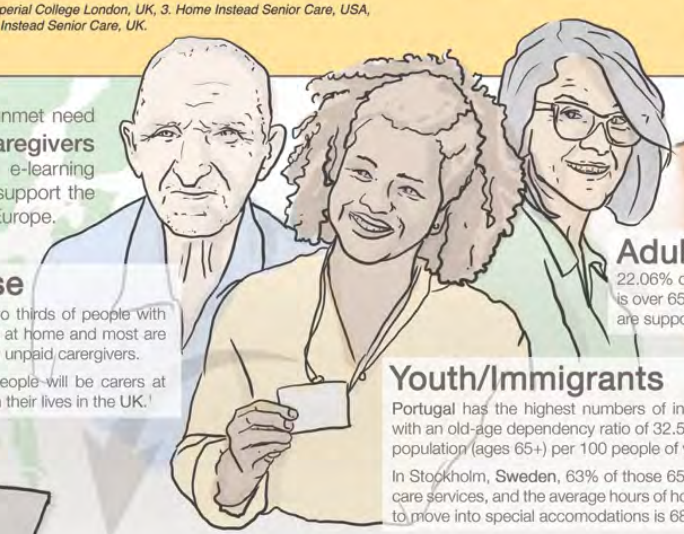
You are **85**, **frail** and might have **dementia**... **who** will take **CARE** of **you**?

Co-development of a comprehensive, open, online, carer education for Europe.

A. Lilienthal[1], E. Muir[2], L. Owen[3], L. Alksten[4], T. Brocklebank[5], M. Somai[2], H. Jansson[1], J. Höög[1], L. Middleton[2]

1. Karolinska Institutet, Sweden, 2. Imperial College London, UK, 3. Home Instead Senior Care, USA, 4. Stockholm Stad, Sweden, 5. Home Instead Senior Care, UK.

Our aim is to cover the unmet need for quality education for **caregivers** through an EIT Health e-learning training program that will support the needs of older citizens in Europe.



Spouse

In the **UK** two thirds of people with dementia live at home and most are supported by unpaid caregivers.

3 out of 5 people will be carers at some point in their lives in the UK.[1]

Adult Child

22.06% of the **German** population is over 65[4] and 2/3 of older citizens are supported by a close relative.

Youth/Immigrants

Portugal has the highest numbers of informal carers without training and with an old-age dependency ratio of 32.5, which is the ratio of the older-age population (ages 65+) per 100 people of working age (ages 15-64).[2]

In Stockholm, **Sweden**, 63% of those 65+ and living at home receive home care services, and the average hours of home care per month before needing to move into special accomodations is 68 hours![3]

Co-Development of Accessible Training

Open Online Courses via edX:

- Introduction to Caring for Older Adults
- Supporting Older Adult Personal Care & Independence Part 1 of 2
- Supporting Older Adult Personal Care & Independence Part 2 of 2,
- Age Related Diseases and Disorders
- Promotion of Healthy Ageing
- Care for Carers
- Technology and Ageing
- The Dynamics of Population Change... You are not Alone
- Nutrition in Ageing
- Caring at End of Life

Partners in CARE

Improve & Increase

- Quaity of life
- Job/relationship satisfaction
- Number of trained carers
- Recognition & employability
- Value proposition of quality care

Do you **CARE**?

What kind of carer are you?

The Spouse

Adult Child

Other Citizen

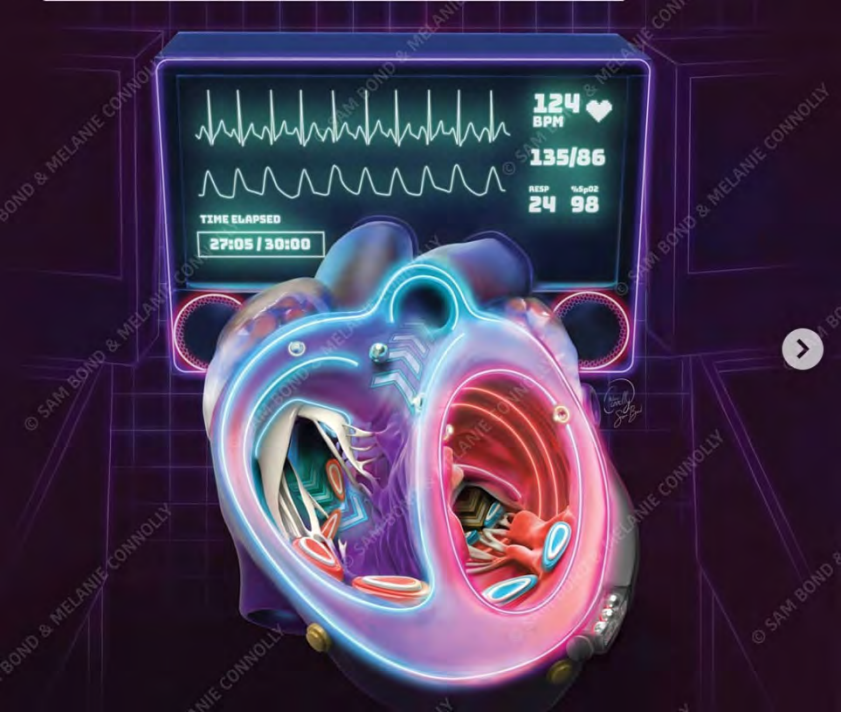
Is the work Paid? Yes / No

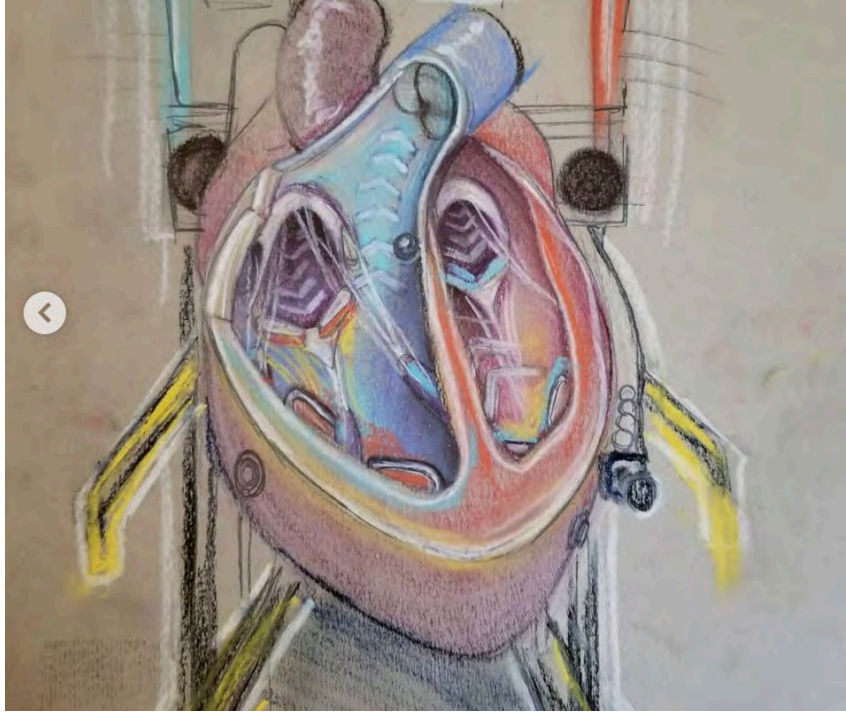
Type of work Full-Time / Part-Time

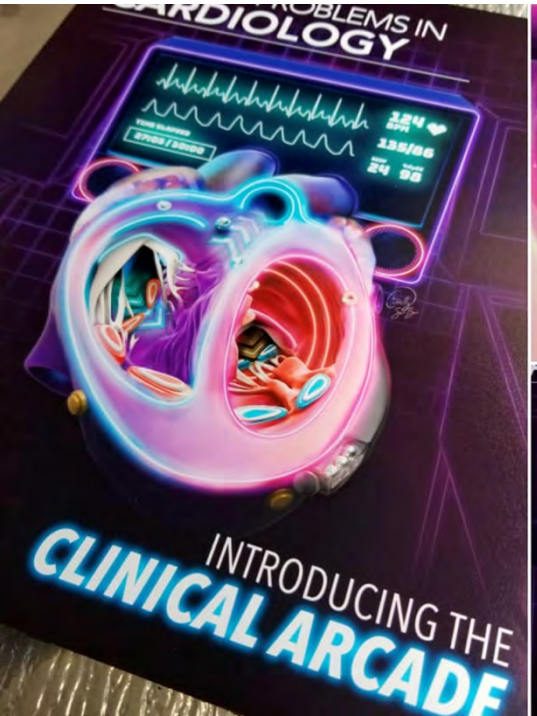
Scan QR code to complete poll

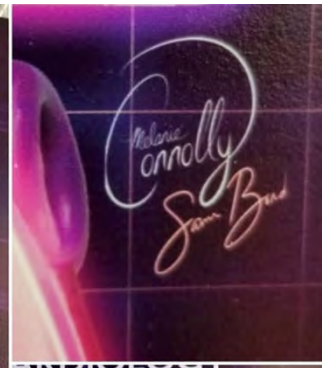
Learn to CARE today!
Visit: **Care-campus.eu**

Poster Designer:
Anneliese Lilienthal

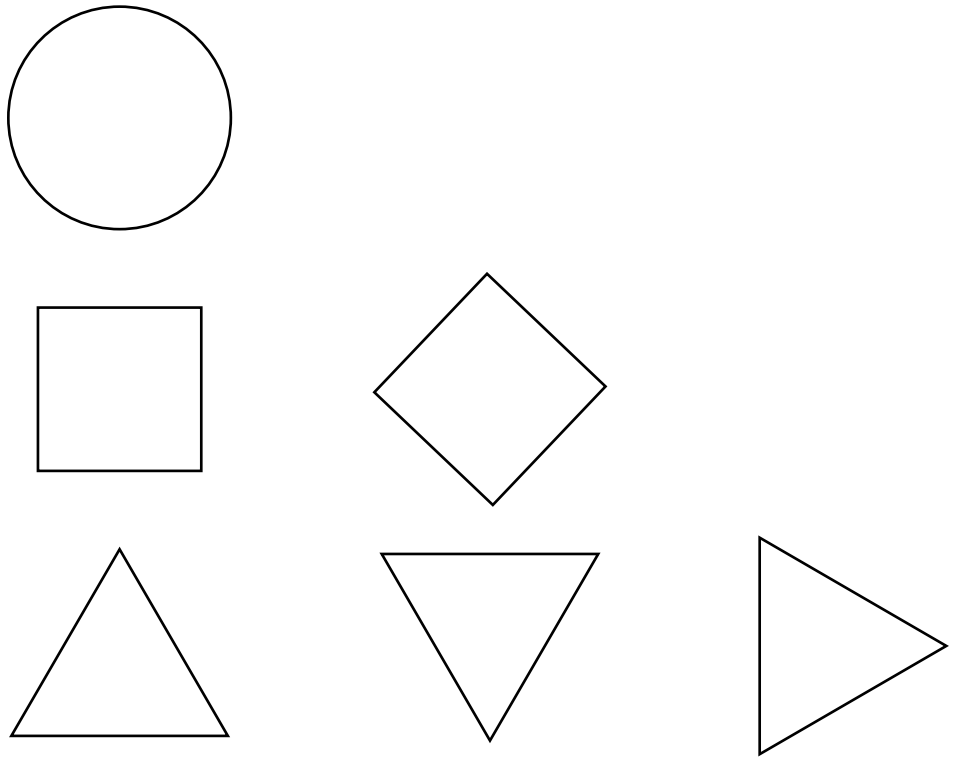








Sam Bond & Melanie Connolly for Meco Visuals



amazon

Cognitive Load

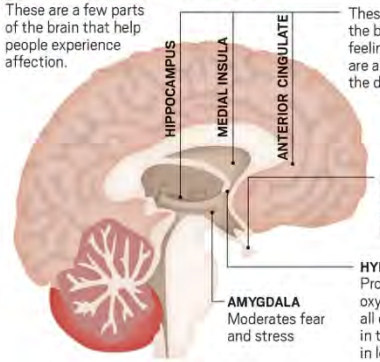
Image Credits: Pixabay

THE SCIENCE OF FALLING IN LOVE

Beyond the love songs, romantic poems, passionate novels and sappy movies, love is the result of complex processes in the body. Here is a breakdown of love's biology and the ways humans experience romance with each other.

WHERE DOES THE BRAIN LOVE?

These are a few parts of the brain that help people experience affection.



These three parts of the brain help regulate feelings of reward. They are also responsible for the development of love

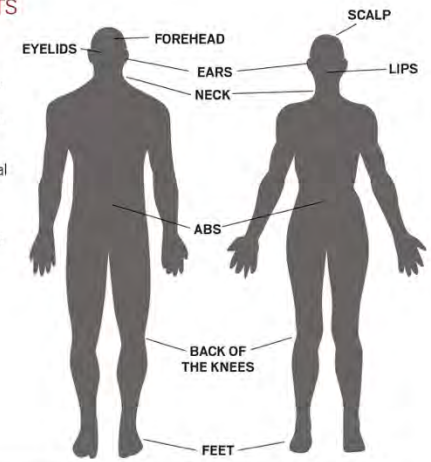
PITUITARY GLAND
Regulates hormones and secretes them into the body

HYPOTHALAMUS
Produces dopamine, oxytocin and vasopressin, all of which are necessary in the process of falling in love

AMYGDALA
Moderates fear and stress

HOT SPOTS

Erogenous zones are parts of the body that are particularly responsive to stimulation, resulting often in sexual excitement. These are popular hot spots on men and women.



SOURCES: 'The neurobiology of love' Semir Zeki, heritage.org, census.gov, womensday.com, princeton.edu

FALLING IN LOVE, STEP BY STEP

1. The hypothalamus releases dopamine into the body, causing feelings of ecstacy and excitement.

2. As dopamine levels increase, serotonin levels decrease.

Serotonin is responsible for a person's mood and appetite, among other things.

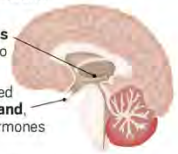
The lower levels of serotonin are similar to levels found in people with obsessive compulsive disorders.

This may result in feelings of obsession or infatuation.

3. Along with dopamine, the body also produces a substance called nerve growth factor.

- NGF is more prevalent in people who are newly in love.
- People who are not in love or are in long-term relationships have lower levels of NGF than recent lovers.
- The amount of NGF in the body directly relates to the intensity of romantic feelings.

4. Oxytocin and vasopressin are responsible for feelings of connection and commitment.



- The **hypothalamus** produces these two hormones.
- They are then stored in the **pituitary gland**, which secretes hormones into the body.
- In times of extreme passion – such as during orgasm – these hormones enter the bloodstream.
- The presence of the two chemicals is often attributed in part to the success of long-term relationships.

5. These hormones affect different parts of the brain. Because of these sections' nearness, certain responses occur:

Activity increases in the romantic core of the brain. → The amygdala deactivates.

A person's standards for judging others grow blurry. → The person in love feels less stress and fear.

The result is an overall feeling of unity between people in love.

DN GRAPHIC ADAM BAUMGARTNER

Sample Infographic discussed

CAUSES OF ANTIBIOTIC RESISTANCE

HANDLE ANTIBIOTICS WITH CARE

Antibiotic resistance happens when bacteria change and become resistant to the antibiotics used to treat the infections they cause.

Over-prescribing of antibiotics

Patients not finishing their treatment

Over-use of antibiotics in livestock and fish farming

Poor infection control in hospitals and clinics

Lack of hygiene and poor sanitation

Lack of new antibiotics being developed

www.who.int/drugresistance

#AntibioticResistance

World Health Organization

Sample Infographic discussed

The Science of Lines

What's really happening at checkout

A shopper can use this **formula,** by John D.C. Little, to determine expected wait time: Average wait time = average number of people in line divided by their arrival rate.

Clock watching

Once a wait lasts longer than three minutes, the perceived wait time multiplies with each passing minute. Shoppers who actually waited five minutes told surveyors they felt they had waited twice as long.

Impulse buying

Mall retailers are copying grocery stores with items like tiny stuffed animals and gift cards next to lines to distract from the wait.

Line jockeying

Short lines are usually short for a reason. Other shoppers may have concluded that a short line has an extremely slow or chatty cashier.

More staff

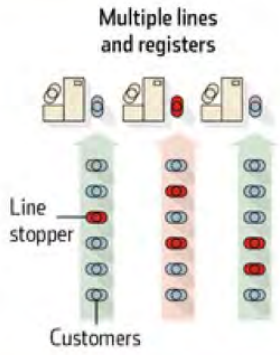
Some stores employ 'runners' at the holidays to assist cashiers. Old Navy sends out 'line expeditors' and 'super helpers' during peak times.

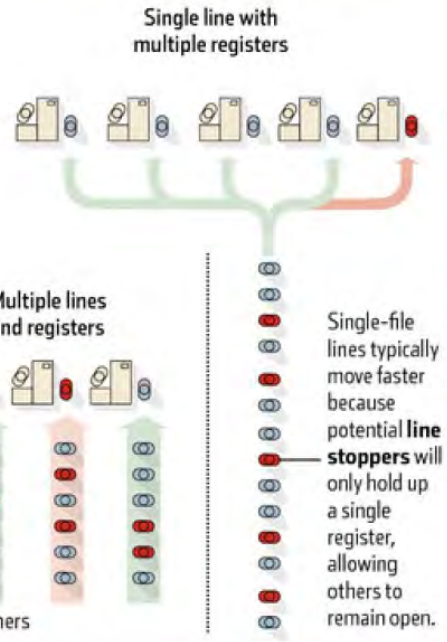
Bailing out

Men are more likely to give up on a line than women. Men start to inflate the amount of time they believe they have waited in line after just two minutes. With women, it's three minutes.

Check It Out

A single-file line leading to three cashiers is about three times faster than having one line for each cashier. At least one of the three lines could have a random event, such as a price check, that would slow the line.

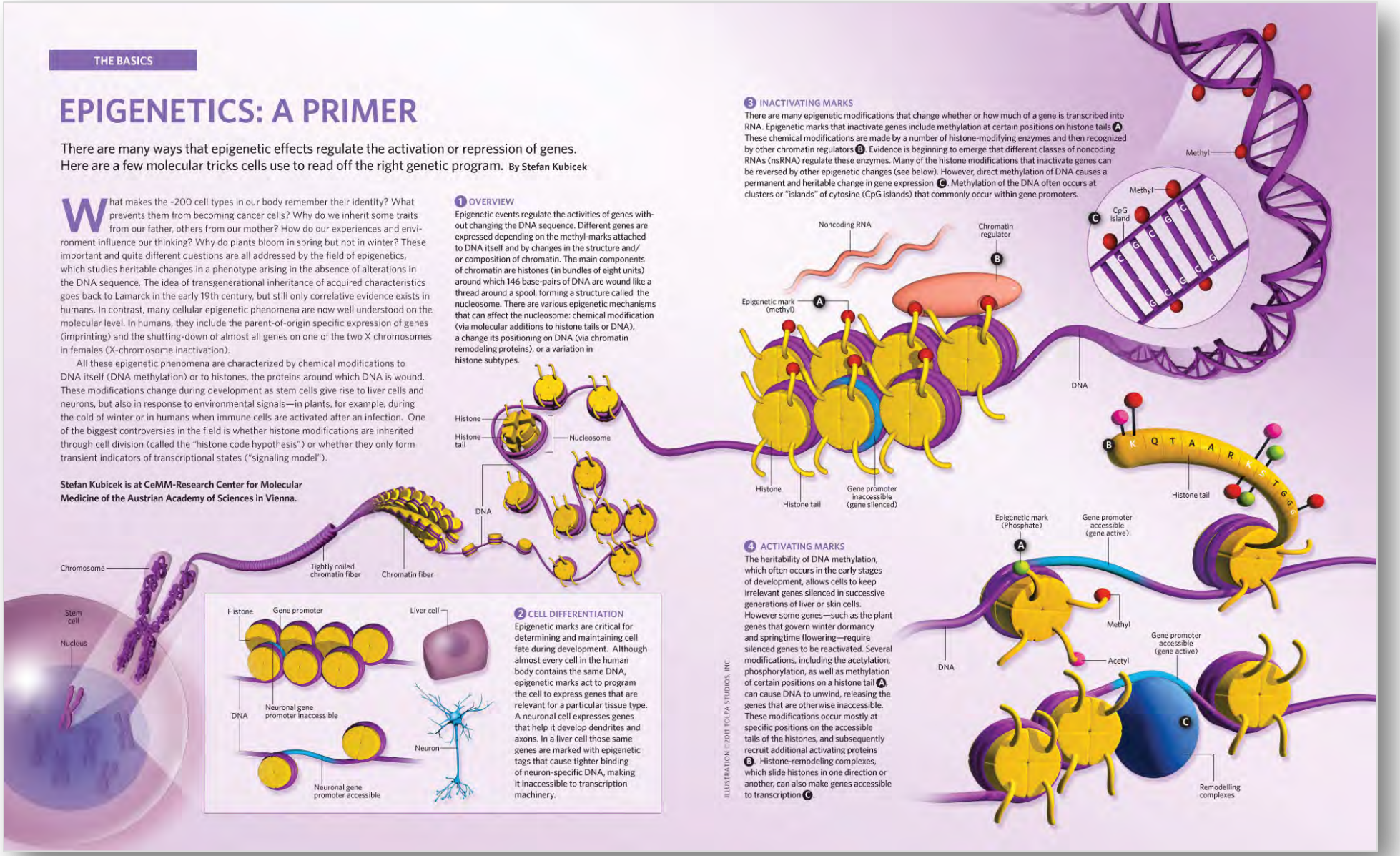



Single line with multiple registers
Single-file lines typically move faster because potential line stoppers will only hold up a single register, allowing others to remain open.

Source: WSJ reporting

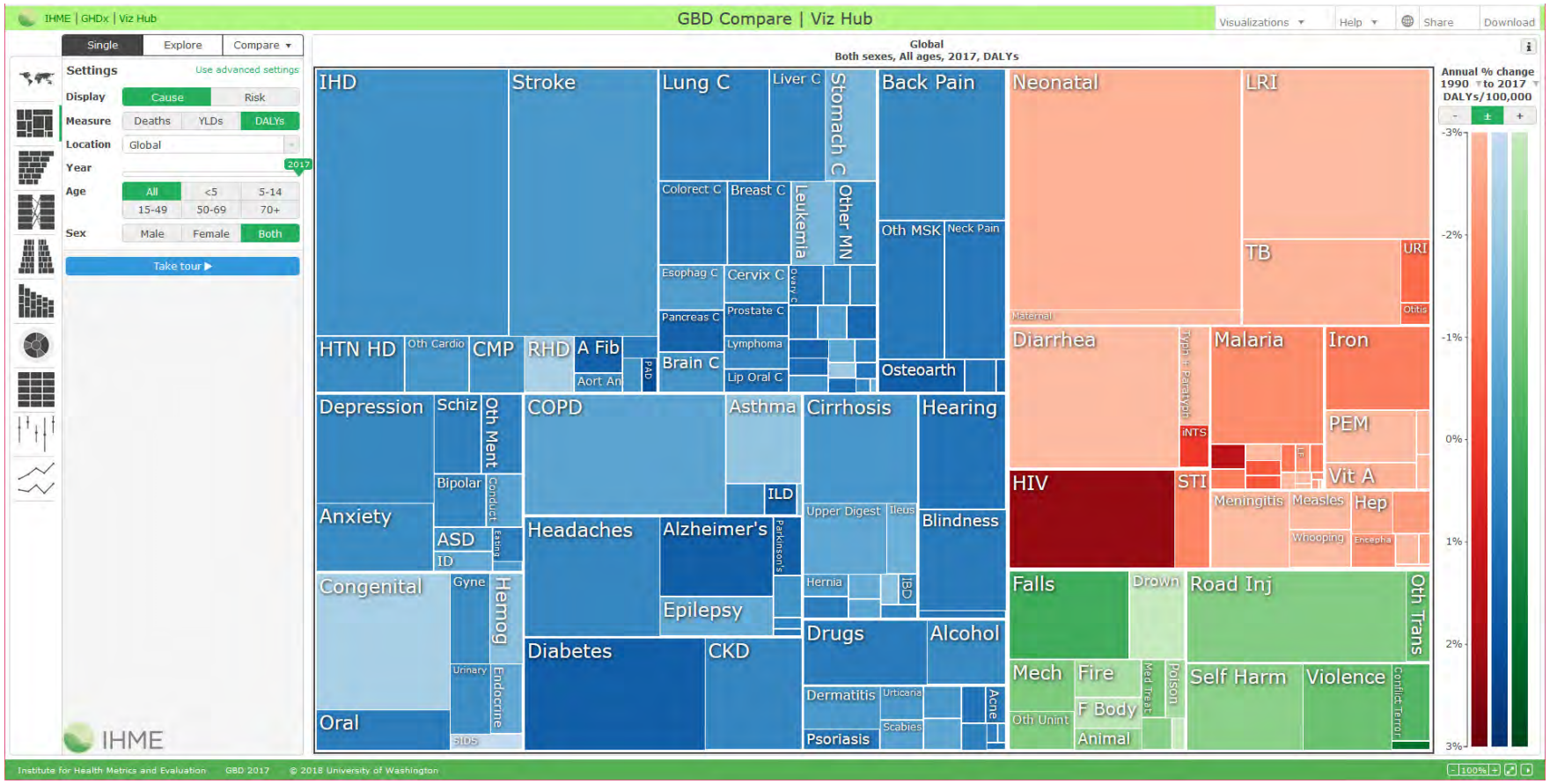
Mike Sudal/The Wall Street Journal

Sample Infographic discussed


THE BASICS
EPIGENETICS: A PRIMER
There are many ways that epigenetic effects regulate the activation or repression of genes. Here are a few molecular tricks cells use to read off the right genetic program. By Stefan Kubicek
What makes the ~200 cell types in our body remember their identity? What prevents them from becoming cancer cells? Why do we inherit some traits from our father, others from our mother? How do our experiences and environment influence our thinking? Why do plants bloom in spring but not in winter? These important and quite different questions are all addressed by the field of epigenetics, which studies heritable changes in a phenotype arising in the absence of alterations in the DNA sequence. The idea of transgenerational inheritance of acquired characteristics goes back to Lamarck in the early 19th century, but still only correlative evidence exists in humans. In contrast, many cellular epigenetic phenomena are now well understood on the molecular level. In humans, they include the parent-of-origin specific expression of genes (imprinting) and the shutting-down of almost all genes on one of the two X chromosomes in females (X-chromosome inactivation).
All these epigenetic phenomena are characterized by chemical modifications to DNA itself (DNA methylation) or to histones, the proteins around which DNA is wound. These modifications change during development as stem cells give rise to liver cells and neurons, but also in response to environmental signals—in plants, for example, during the cold of winter or in humans when immune cells are activated after an infection. One of the biggest controversies in the field is whether histone modifications are inherited through cell division (called the "histone code hypothesis") or whether they only form transient indicators of transcriptional states ("signaling model").
Stefan Kubicek is at CeMM-Research Center for Molecular Medicine of the Austrian Academy of Sciences in Vienna.
1 OVERVIEW
Epigenetic events regulate the activities of genes without changing the DNA sequence. Different genes are expressed depending on the methyl-marks attached to DNA itself and by changes in the structure and/or composition of chromatin. The main components of chromatin are histones (in bundles of eight units) around which 146 base-pairs of DNA are wound like a thread around a spool, forming a structure called the nucleosome. There are various epigenetic mechanisms that can affect the nucleosome: chemical modification (via molecular additions to histone tails or DNA), a change its positioning on DNA (via chromatin remodeling proteins), or a variation in histone subtypes.
Histone
Histone tail
Nucleosome
DNA
Chromosome
Tightly coiled chromatin fiber
Chromatin fiber
Stem cell
Nucleus
Histone
Gene promoter
Liver cell
DNA
Neuronal gene promoter inaccessible
Neuron
Neuronal gene promoter accessible
2 CELL DIFFERENTIATION
Epigenetic marks are critical for determining and maintaining cell fate during development. Although almost every cell in the human body contains the same DNA, epigenetic marks act to program the cell to express genes that are relevant for a particular tissue type. A neuronal cell expresses genes that help it develop dendrites and axons. In a liver cell those same genes are marked with epigenetic tags that cause tighter binding of neuron-specific DNA, making it inaccessible to transcription machinery.
3 INACTIVATING MARKS
There are many epigenetic modifications that change whether or how much of a gene is transcribed into RNA. Epigenetic marks that inactivate genes include methylation at certain positions on histone tails A. These chemical modifications are made by a number of histone-modifying enzymes and then recognized by other chromatin regulators B. Evidence is beginning to emerge that different classes of noncoding RNAs (nsRNA) regulate these enzymes. Many of the histone modifications that inactivate genes can be reversed by other epigenetic changes (see below). However, direct methylation of DNA causes a permanent and heritable change in gene expression C. Methylation of the DNA often occurs at clusters or "islands" of cytosine (CpG islands) that commonly occur within gene promoters.
Noncoding RNA
Chromatin regulator
Epigenetic mark (methyl)
Histone
Histone tail
Gene promoter inaccessible (gene silenced)
Methyl
CpG island
DNA
Histone tail
4 ACTIVATING MARKS
The heritability of DNA methylation, which often occurs in the early stages of development, allows cells to keep irrelevant genes silenced in successive generations of liver or skin cells. However some genes—such as the plant genes that govern winter dormancy and springtime flowering—require silenced genes to be reactivated. Several modifications, including the acetylation, phosphorylation, as well as methylation of certain positions on a histone tail A, can cause DNA to unwind, releasing the genes that are otherwise inaccessible. These modifications occur mostly at specific positions on the accessible tails of the histones, and subsequently recruit additional activating proteins B. Histone-remodeling complexes, which slide histones in one direction or another, can also make genes accessible to transcription C.
Epigenetic mark (Phosphate)
Gene promoter accessible (gene active)
Methyl
Acetyl
DNA
Gene promoter accessible (gene active)
Remodelling complexes
ILLUSTRATION ©2011 TOLPA STUDIOS, INC.

Sample Infographic discussed www.the-scientist.com/images/PDF/**epigenetics_primer**.pdf Illustrator: Tami Tolpa

Images are based upon public signage in Sweden.



Sample Dashboards, http://www.healthdata.org/results/data-visualizations & Garmin Connect

Frustration

Image Credits: Pixabay

Increase in HIV-1 Envelope Incorporation into Virions Mediated by Genetic Modification of the Cytoplasmic Tail of Env

Michael J. Hogan, Andrea P. O. Jordan, Samra Elser, Angela Conde, Drew Weissman and James A. Hoxie

Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, USA

ABSTRACT

Background: Vaccine-elicited antibody responses against HIV Env are characteristically weak and short-lived. One method to induce a potent antibody response is to present antigen as a dense array on viral particles. However, this approach has proven challenging for HIV, which naturally expresses Env at low levels on virions. Although Env incorporation into particles can sometimes be increased by removal of the cytoplasmic tail, this effect is generally modest. Based on rational manipulation of trafficking signals in the cytoplasmic tails of HIV and SIV Env that can positively or negatively regulate Env incorporation, we sought to derive virion-based immunogens with greatly enhanced levels of Env trimers.

Methods: The cytoplasmic tail of HIV-1 was modified 1) to remove all known endocytosis signals and 2) to incorporate a segment from the SIV Env cytoplasmic tail that can positively affect Env incorporation. We generated virions from HEK 293T cells and quantified Env incorporation via the Env:Gag ratio, as measured by antigen-capture ELISA for p24 and gp120.

Results: Envelopes that lacked a cytoplasmic tail and/or contained mutations that ablated known endocytosis signals resulted in a ≤2-fold increase in Env content on virions. However, when HIV-1 Env also contained a 13 amino acid segment from the proximal region of the SIV Env cytoplasmic tail, Env incorporation could be increased 3- to 8-fold. In contrast to other reported approaches to increase HIV-1 Env incorporation, viruses containing these changes could establish a spreading infection in CD4+ T cell lines.

Conclusion: The novel Env modifications we describe here may be applied in combination with other approaches to increase the surface density of Env on inactivated virus or virus-like particle vaccines. The effect of these modifications on immunogenicity is currently under investigation.

BACKGROUND

- The antibody response mounted against HIV-1 Env-based vaccines is characteristically weak and short-lived.
- Antigens that are presented in a dense array, as on the surface of some viral particles, have the potential to crosslink B cell receptors and typically induce potent and long-lived antibody responses.
- Viral particles hold promise as HIV-1 immunogens due to their ability to present Env trimers in their native conformation and orientation; however, wild-type HIV-1 virions contain very few Env trimers per particle (e.g. Zhu et al, PNAS 2003). Previously published methods to increase Env incorporation generally make use of non-replicating virus-like particles (VLPs).

  Approaches to increase the number of Env trimers incorporated into virions in the context of replication-competent HIV-1 could be useful for large-scale production of potential Env-based immunogens.
- Although truncations of the SIVmac Env cytoplasmic tail (CT) and ablation of its membrane-proximal Tyr-dependent endocytosis signal (GYRPV) can markedly increase (~8-fold) Env incorporation into virions (see Fig. 1), analogous changes in HIV-1 fail to have this effect. The basis of this difference between HIV-1 and SIVmac is poorly understood.

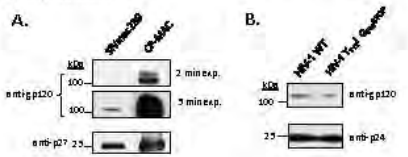


Figure 1. Western blots show changes in virion-associated Env relative to capsid protein for the indicated SIV and HIV-1 variants. (A) CP-MAC, an SIVmac variant derived from BK28, shows an 8-fold increase in gp120 relative to p27 compared to wild-type SIVmac239. (CP-MAC virions provided by Julian Bess and Elena Chertova, NCI-Frederick). The CP-MAC Env CT contains a $Y_{712}C$ mutation and a premature stop codon at a.a. position 736 that fully account for this effect (Sauter et al., JCB 1996). (B) $HIV\text{-}1_{NL4\text{-}3(CD3)}$ virions do not exhibit this effect when analogous mutations are made (i.e. $Y_{712}I$ plus a stop codon at a.a. position 718).

➢ We hypothesize (1) that the membrane-proximal region of the cytoplasmic tail of SIVmac positively regulates Env incorporation into virions; and (2) that this region could increase virion incorporation of HIV-1 Env when introduced in its CT.

RESULTS

Mutations introduced into the HIV-1 Env CT to increase Env content on virions:

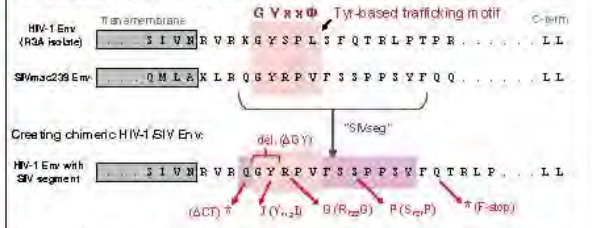


Figure 2. A 13-amino acid segment in the SIV CT, termed "SIVseg," that contains a conserved Tyr-based endocytosis motif (GYxxΦ) and seven residues (FSSPPSY) not present in HIV-1 was constructed within the CT of $HIV\text{-}1_{R3A}$ Env. Additional mutations made in various combinations include $Y_{712}I$ and $\Delta GY_{711-712}$ (both knocking out the GYxxΦ motif), a premature stop codon after Phe_{717} (termed F-stop), and a stop codon at a.a. position 710 that largely eliminates the CT (ΔCT). Additional substitutions $R_{722}G$ and $S_{727}P$ (SIV numbering) were introduced, as these changes arose in vivo in SIVmac239ΔGY-infected macaques and were associated with progression to AIDS (Breed et al, JVI 2013) and increased Env incorporation in the context of SIVmac239 ΔGY.

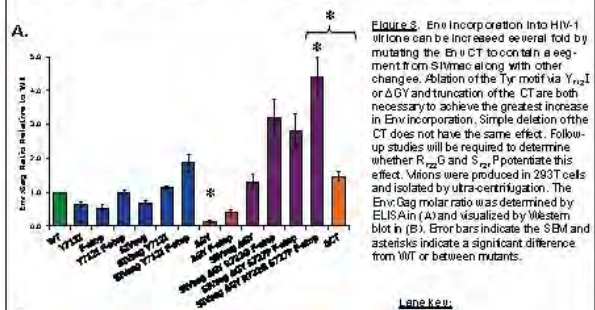


Figure 3. Env incorporation into HIV-1 virions can be increased several fold by mutating the Env CT to contain a segment from SIVmac along with other changes. Ablation of the Tyr motif via $Y_{712}I$ or ΔGY and truncation of the CT are both necessary to achieve the greatest increase in Env incorporation. Simple deletion of the CT does not have the same effect. Follow-up studies will be required to determine whether $R_{722}G$ and $S_{727}P$ potentiate this effect. Virions were produced in 293T cells and isolated by ultra-centrifugation. The Env:Gag molar ratio was determined by ELISA in (A) and visualized by Western blot in (B). Error bars indicate the SEM and asterisks indicate a significant difference from WT or between mutants.

Figure 4. $HIV\text{-}1_{NL4\text{-}3(CD3)}$ variants containing the SIV segment, truncations, and other cytoplasmic tail modifications are replication-competent in CEM and SupT1-CCR5+ CD4+ T cells. Shown at right, spreading infections were monitored by sampling the pelletable reverse transcriptase (RT) activity of SupT1 culture supernatant over time.

Importantly, viral DNA from cells infected with the mutant SIVseg, ΔGY, $R_{722}G$, $S_{727}P$, F-stop was sequenced at the time of peak infection, and the cytoplasmic tail mutations were maintained throughout the course of the infection (n = 3).

These results indicate that the mutant Envs retain a functional conformation, and that large-scale production of viruses with modified Env CTs might be feasible.

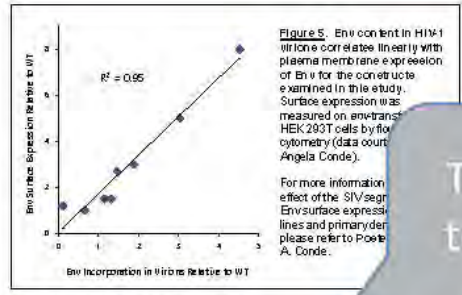


Figure 5. Env content in HIV-1 virions correlates linearly with plasma membrane expression of Env for the constructs examined in this study. Surface expression was measured on env-transf... HEK 293T cells by flo... cytometry (data court... Angela Conde).

For more information... effect of the SIVseg... Env surface expressi... lines and primary der... please refer to Poste... A. Conde.

PROPOSED MODELS

Possible explanations for the effect of SIVseg on Env incorpor... HIV-... (1) an active process, whereby the short CT interacts with t... viral facto... actively recruit Env into budding virions, or (2) a passive process, whereby more Env is recruited into virions due to the fact that the steady-state level of Env on the plasma membrane has been increased. The data in Fig. 5 are consistent with a passive process, in which a variety of trafficking pathways may be affected, as depicted below.

CONCLUSIONS & FUTURE DIRECTIONS

1. A region from the SIVmac Env CT can positively regulate Env content in virions when inserted into an HIV-1 Env, especially when the GYxxΦ cellular trafficking signal is ablated. This increase is greater than when the CT is simply deleted.
2. The greatest increase in Env incorporation (mean of 4.5-fold; range of 2.5 to 8.3-fold) was seen for Envs containing the SIVseg, ΔGY, F-stop, and the $R_{722}G$ and $S_{727}P$ changes.
3. Increases in Env content on virions produced by these mutations corresponded directly to an increase in Env expression on the cell surface.
4. Remarkably, viruses containing the SIV segment and these additional CT mutations remain replication-competent and stable during propagation in $CD4^+$ T-cell lines, indicating that Env is fully functional and suggesting that these particles can be produced in bulk quantities to explore their immunogenicity.

➢ In future studies, we will address the following questions:

- Can these CT mutations increase Env content for diverse HIV-1 isolates and in different cell types?
- What are the underlying mechanisms for increased Env expression on the cell surface and for increased Env incorporation into virions?
- What is the contribution of ΔGY and of the $R_{722}G$ and $S_{727}P$ mutations?
- In the context of established methods to inactivate virions while leaving Env structurally intact, will HIV-1 viral particles engineered to display increased levels of Env trimers stimulate an improved antibody response (e.g. titers, effector function, duration) when used as immunogens?

ACKNOWLEDGMENTS

This work was supported by NIH grant AI090788-01, NIH training grant T32 AI007632-14, and a Bill and Melinda Gates Foundation CAVD grant, and by core services from the Penn Center for AIDS Research (CFAR), an NIH-funded program (P30 AI045008).

Text too close to edges. Too much text!

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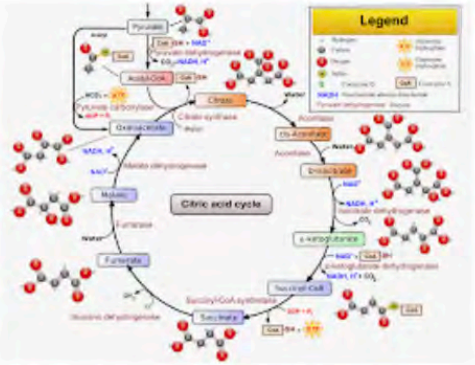

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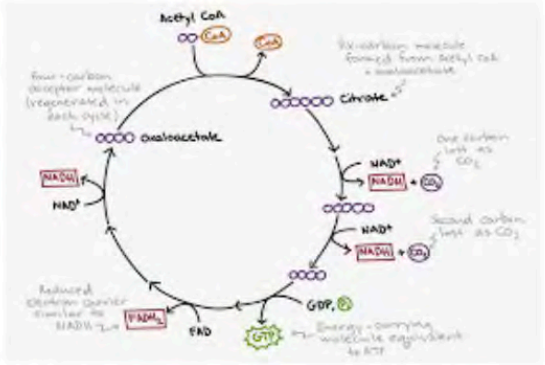

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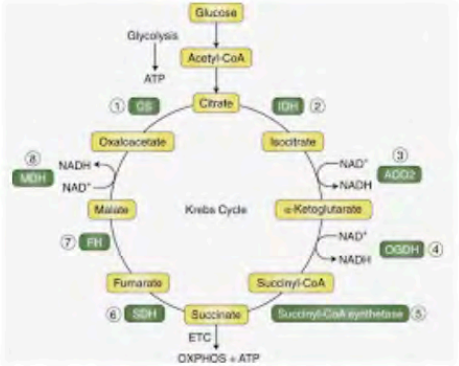

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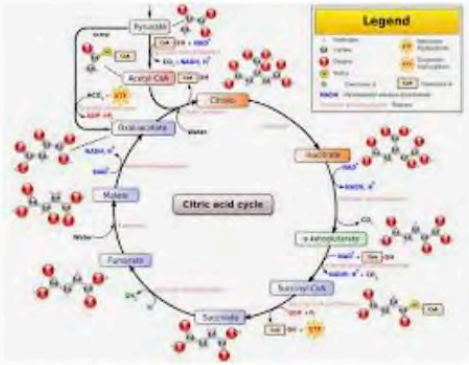

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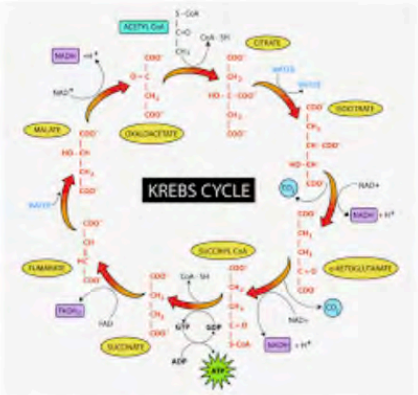

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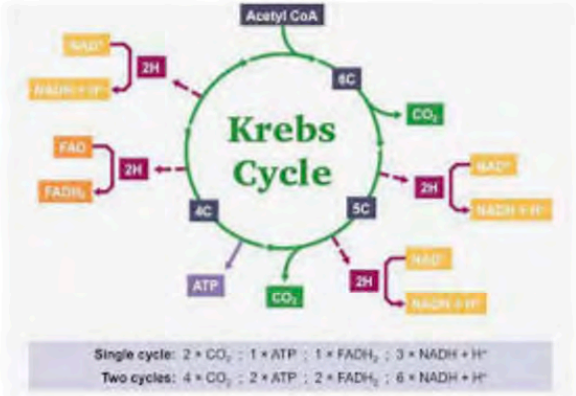
Acetyl CoA
Krebs Cycle
2H
FAD
FADH2
4C
5C
6C
ATP
CO2
Single cycle: 2 × CO2 ; 1 × ATP ; 1 × FADH2 ; 3 × NADH + H+
Two cycles: 4 × CO2 ; 2 × ATP ; 2 × FADH2 ; 6 × NADH + H+

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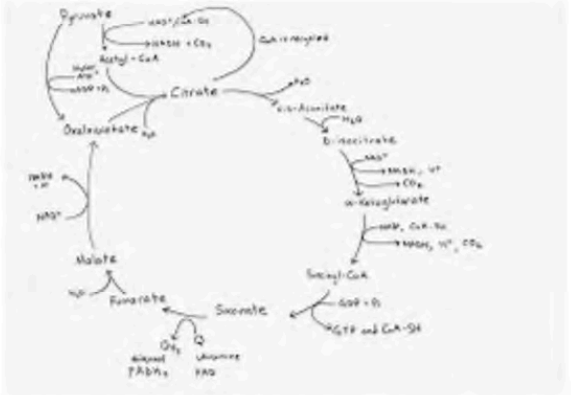

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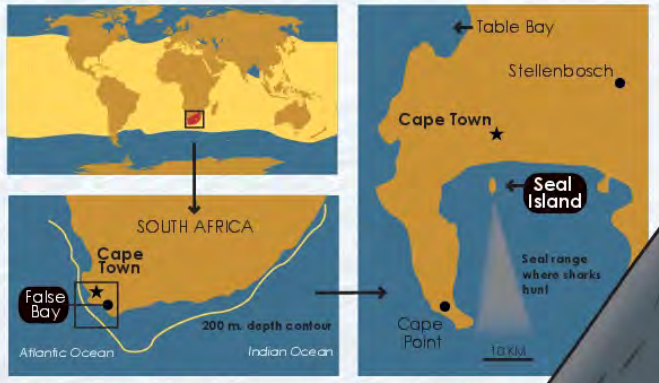
Images from Google image search for Krebs Cycle

GREAT WHITE SHARKS

The reality about these astounding creatures

South Africa is home to one of the world's most feared sea creatures: Great White Sharks. Most people fall vicitim to the common misconception that this animals' appearance correlates with their level of aggression towards humans. In reality, it is a selective animal that **only hunts to survive**. Hammerschlag and his team have conducted a 10 year research study in False Bay, where he monitored the sharks in the area without physically touching them. He was able to discover how they hunt and how they can be further protected as they are endangered species.

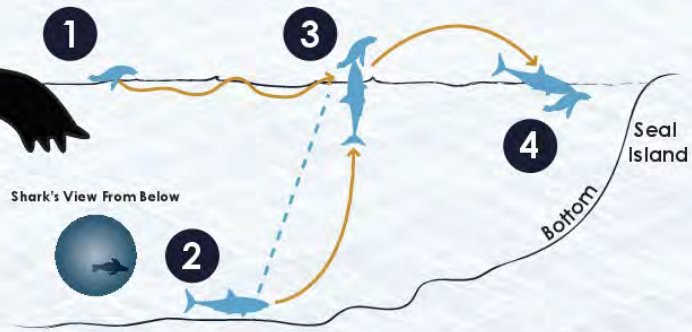
Where do they live?



Most Great White Sharks are concentrated in the above mentioned lighly shaded region and tend to concentrate in **warm waters**. Great Whites congregate in False Bay not only because of the warm temperature, but because there is also a **large seal colony** that lives on Seal Island. The triangle extending from the Island depicts the range of the seals that leave and return to the island. Said triangle is the area where most sharks wait to attack their **prey at dawn**. Dawn provides the ideal hunting conditions because of **murky water** and **limited visibility**.

*The shark's hunting **success rate decreases after its first try**. The more the seal tries to defend itself, the harder it gets to hunt it.*

And how do they hunt?

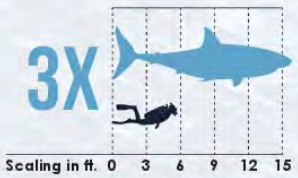


1. The **seal** makes its way through the ocean as the shark **approaches silently** watching the seal from the bottom.
2. From the bottom the **shark** has an ideal view of the seal. It swims rapidly upwards to **surprise attack** the defensless prey.
3. The shark hits the seal with an extremely **powerful force**. During the **ambush**, both animals fly out of the water.
4. After the impact the shark lands back into the ocean and starts eating. The seal will **satisfy** him for approximately **one full month**.

Facts and characteristics

Great Whites can reach speeds up to 25 MPH when trying to ambush its prey. **Big seals** are a **threat** to sharks because of **biting and scratching**. Also, seals can reverse direction as quickly as a shark.

These sharks are approximately three times as large as a human and the **biggest** ever **recorded** was **20 ft**. **Big sharks** have more **focused** and **centered anchor points** in order to hunt as they exclude the small sharks from the better spots.



Conservation efforts

Great Whites' **biggest threats are humans** who hunt them for their fins. The big problem with this is that they reach sexual maturity at 15 years of age and have an 11-month gestation period. This means they **can't reproduce as fast** as they are **being predated**. According to the IUCN Red List, some countries including South Africa have implemented laws protecting them from predation.

Produced by Ian Perchik
Sources: RJ Dunlap Marine Conservation Program
N. Hammerschlag

Sample Infographic discussed

Image Credits: Pu Tai

The Case of Ken Lowery

Visual knowledge building and translation of volumetric radiographic imagery for dynamic 3D medical legal visualization

Amanda Miller(BA, MScBMC candidate)[1], Leila Lax (BA, BScAAM, MEd, PhD)[1], Nick Woolridge (BFA, BScBMC, MSc, CMI)[1], Anne Agur (BSc(OT), MSc, PhD)[2]

1. Biomedical Communications, Institute of Medical Science, Faculty of Medicine, University of Toronto; 2. Division of Anatomy, Department of Surgery, University of Toronto

Master of Science in **Biomedical Communications**

Institute of Medical Science
UNIVERSITY OF TORONTO

Abstract

Volumetric imaging provides more comprehensive information than 2D imaging (e.g. CT scans and MRIs), but is more complicated to interpret, especially for a non-medical audience. This animation is designed to support medical expert testimony and provide a jury with an engaging, didactic experience to assist them in visualizing traumatic brain injuries three-dimensionally by incorporating volumetric imaging and animated sequences. A design research study of the 3D medical legal animation was conducted with a mock jury, personal injury lawyers, and medical experts. The pre/post-test results from mock jurors demonstrated 44% knowledge improvement, from 33% on pre-test to 77% on post-test.

Introduction

The purpose of this research project is to:

- **Create** a medical legal animation that incorporates volumetric radiographic imaging, combined with 3D anatomical models and animated sequences that conveys the full extent of the plaintiff's injuries.
- **Evaluate** the effect that these 3D visual explanations have on improving a mock jury's knowledge of the medical content and understanding of volumetric radiographic images by conducting a design research pre/post-test study.[1,2]
- **Obtain** feedback from mock jurors, personal injury lawyers, and medical experts through design research survey results and focus group sessions on usability and utility of the 3D medical legal animation for courtroom demonstrative evidence.[2]

Materials & Methods

Media Design Methods

3D Models extracted from the plaintiff's CT data were cleaned and retopologized in Pixologic ZBrush (**Fig. 1**).

Figure 1. *Process of restoring detail back to the 3D models from low resolution CT scan data.*

Storyboards, 3D models, and animations were iteratively evaluated by committee members to obtain feedback on visual clarity and ensure anatomical accuracy (**Fig. 2**).

Throughout the development of the medical legal animation, specific **design strategies**[2,3] were employed to help foster knowledge building and translation of complex case information.

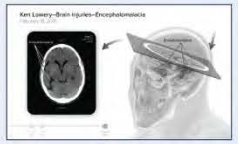


Figure 2. *Storyboard image showing encephalomalacia.*

- **Transparency.** To contextualize neuroanatomical spatial relationships and form connections between structures (**Fig. 3a,b**).
- **Saturation.** To focus viewer attention on areas of importance (**Fig. 3b**).
- **Colour coding.** To clarify, simplify, and group corresponding elements in radiographs and medical models (**Fig. 3c,d**).
- **Model movement constraints.** To tell a concise case story.

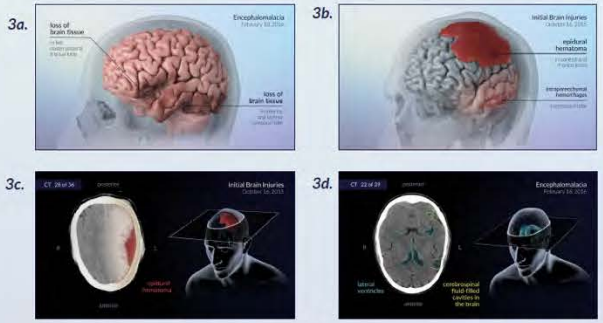


Figure 3. *Still images from the 3D animation highlighting specific design strategies.*

Research Methods

Twenty mock jury participants were asked to complete a pre-test based on case and radiographic image content before they viewed the animation, followed by a post-test with the questions randomized to examine knowledge improvement. An online design research survey was used to obtain formative feedback on multiple dimensions of media design and utility from mock jurors, personal injury lawyers and medical experts (n=32). A focus group debriefing session was conducted to obtain further information regarding the strengths and weakness of clarity of visual information, level of understanding, and overall educational design.

Results

Pre/post-test results demonstrated a 44% increase in knowledge from 33% to 77% (**Fig. 4**). The range of scores on pre-test was 8% to 64% with a median score of 28%; the range of scores on post-test was 52% to 92% with a median score of 82%.

Figure 4. *Neuroanatomy pre-test and post-test results from 20 mock juror participants.*

Overall, mock jurors, lawyers, and medical experts agreed/strongly agreed that medical legal animations have an important role to play in juror understanding. They concluded that this animation would help the jury understand the medical story and neuro-radiological images presented in the case.

"It was absolutely helpful and would most definitely be beneficial for a jury" -Lawyer

Discussion & Conclusions

This design research study successfully demonstrated the need for 3D medical legal animations as a knowledge building tool, especially when volumetric radiographic imaging is involved. The utility and usability of 3D animation for demonstrative evidence was verified by lawyers and medical experts. Strong evidence in this study confirms the importance of medical legal visualizations and the impact they have on juror knowledge and understanding. Ultimately visual knowledge building scaffolds understanding of medical complexity, which translates to better decision-making in personal injury cases, such as that of Ken Lowery.

Bibliography

1. Bereiter, C. 2002. Design research for sustained innovation. Cognitive Studies, Bulletin of the Japanese Cognitive Science Society, 9(3):321–327.

2. Lax, L., Taylor, I., Wilson-Pauwels, L., and Scardamalia, M. (2004). Dynamic Curriculum Design in Biomedical Communications: Integrating a Knowledge Building Approach and a Knowledge Forum® Learning Environment in a Medical Legal Visualization Course. Journal of Biocommunications. 30:1.

3. Mader, S. (2013). Demonstrative Evidence: Innovative approaches for Impactful Persuasion. Artery Studios website. http://arterystudios.com/legal/wp-content/uploads/2013/11/Demonstrative-Evidence-Innovative- Approaches-to-Impactful-Persuasion.pdf. Accessed on: June 3, 2017.

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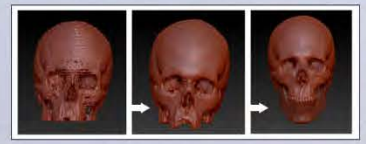

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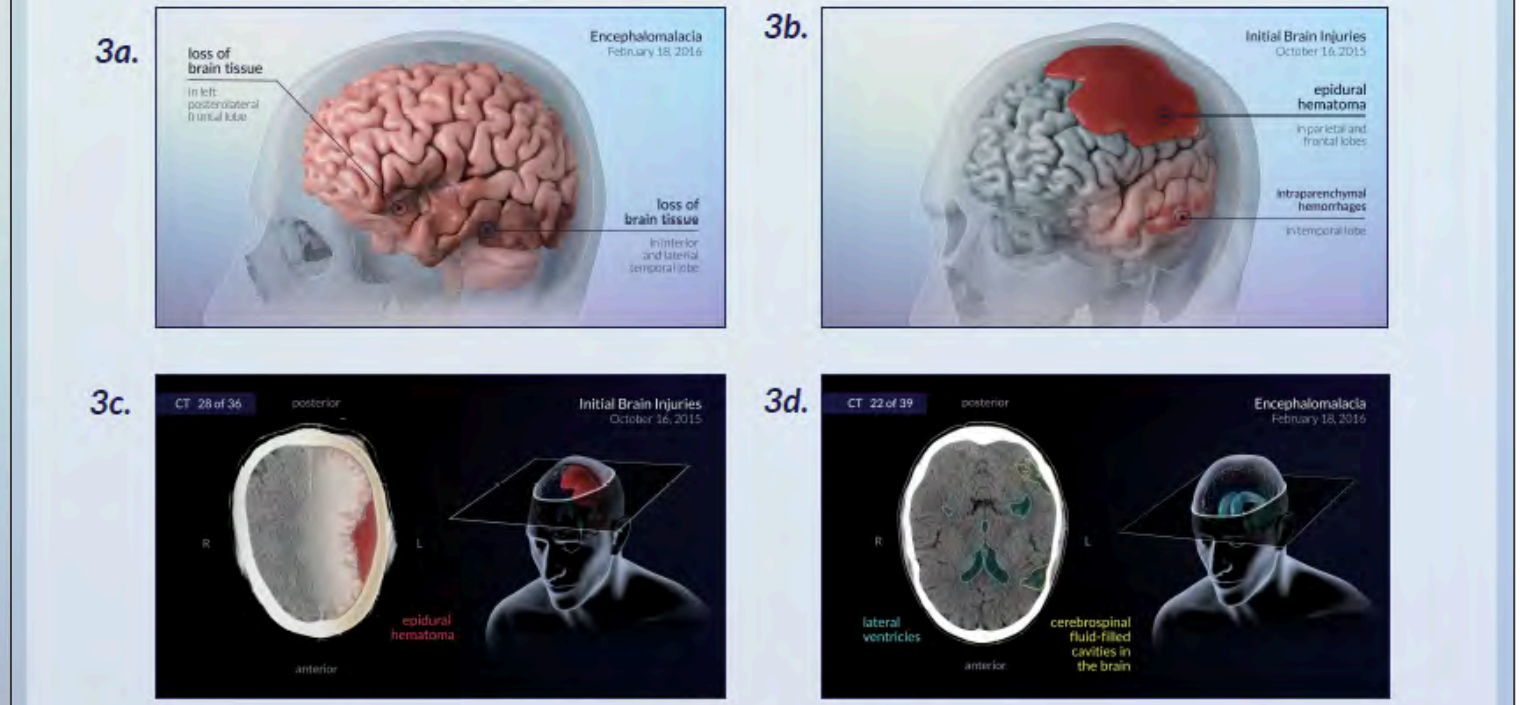

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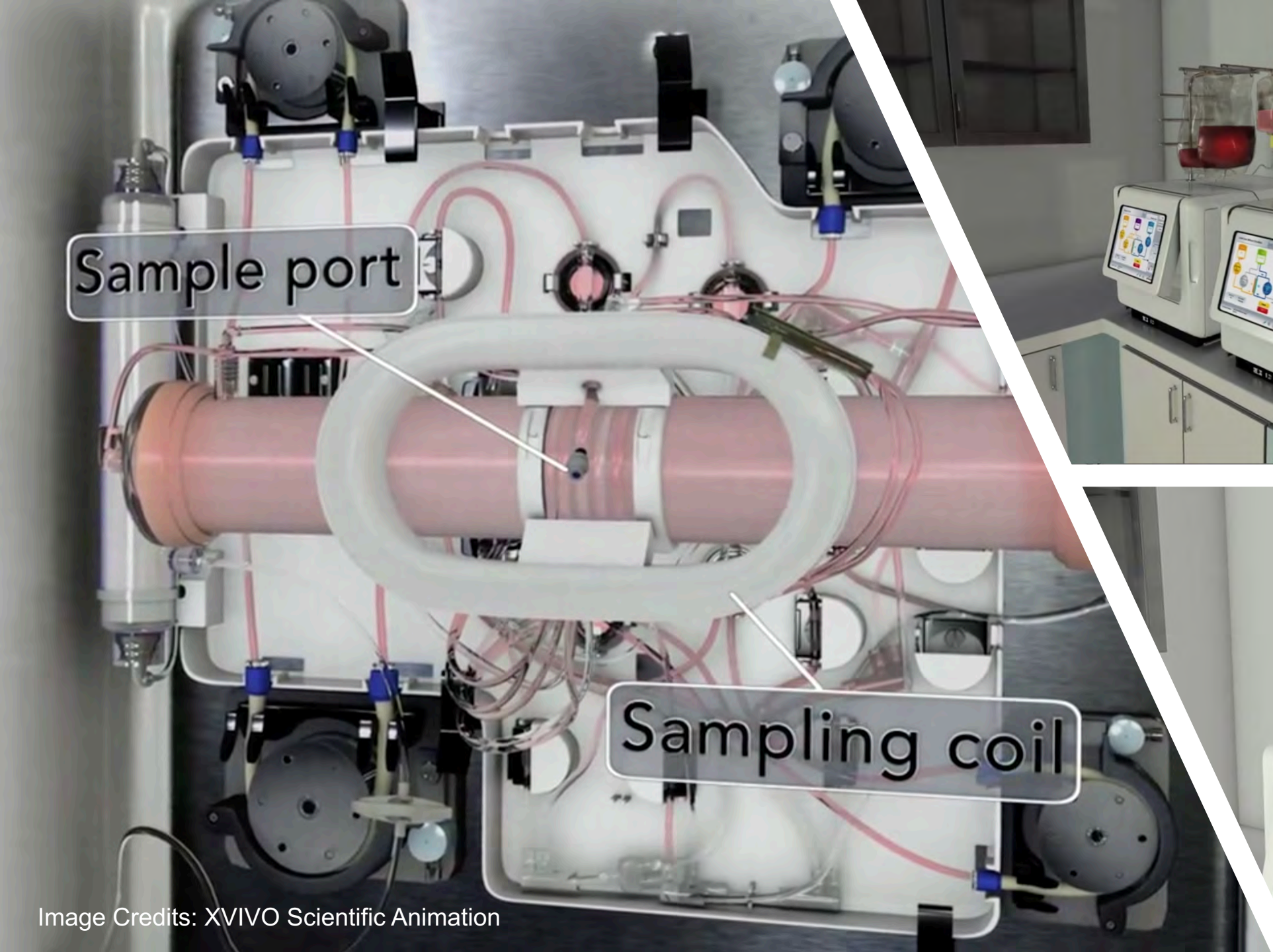

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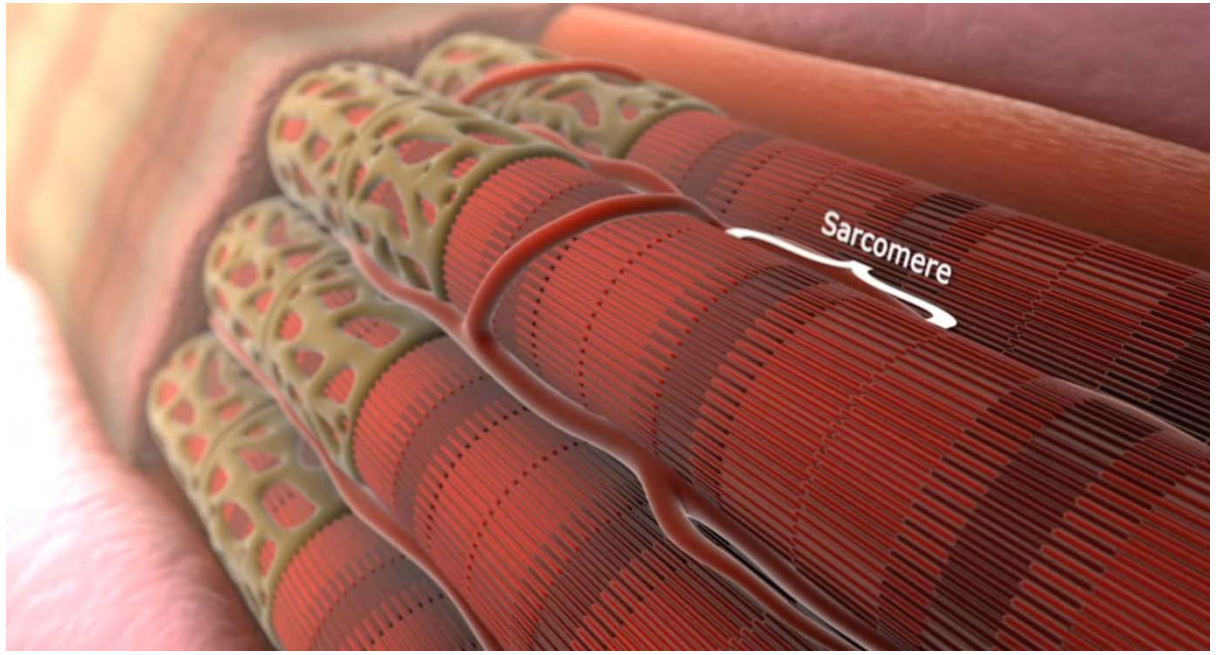

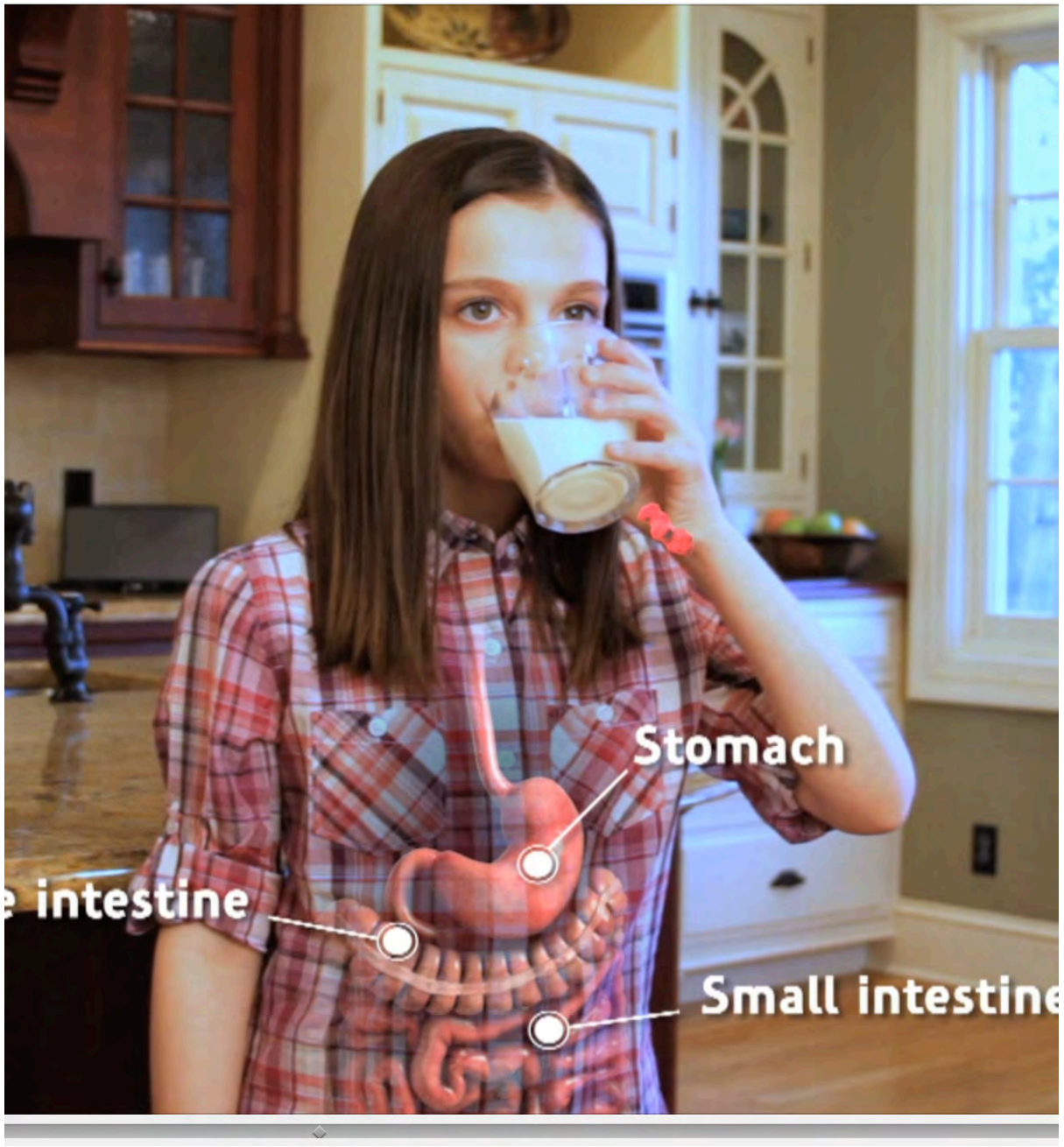

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360° Endocrine Cells Animation (demo)

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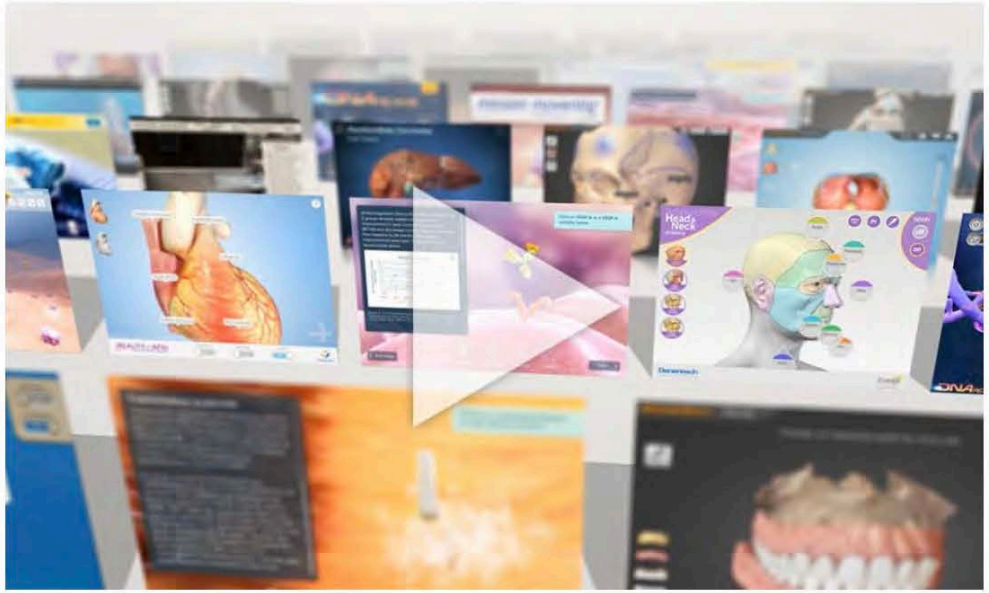

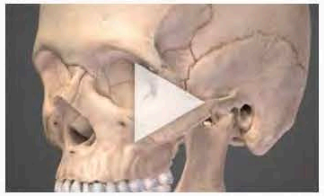

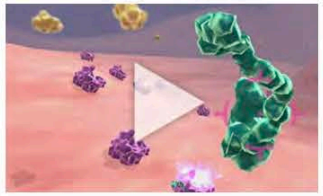

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Adapting a Haptic Motor-Skill Simulator to Include 3D Histology and Supporting Information Architecture (IA)

Nova Hayes[1] MS, Karen Bucher[1] MA, CMI, FAMI, Seema Ashrafi[2] DDS, MS, Leah Leibowicz[1] MS, CMI

1 Department of Biomedical Visualization, The University of Illinois at Chicago

2 College of Dentistry, The University of Illinois at Chicago

Abstract

3D-model and Information-Architecture (IA) design were brought into question when revising an existing haptic-based, periodontal-probing simulator with expanded learning goals. Despite the increasing prevalence of simulator training and research performed in this field, clear guidelines are lacking on 3D modeling for a haptic interface in which polygon and surface material constraints exist. A virtual model of a mandibular section was sculpted with histological features to present clinically relevant detail in context with the motor-skill exercise. The architecture includes additional approaches to the content supplementary to procedural training to mediate learning. This prototype intends to exhibit how these attributes can alter a single-objective task trainer into a holistic and interactive educational experience.

Hypotheses

1) Visually representing the anatomy of the gingival tissue will allow students to appreciate the structures affected during probing procedure as well as reinforce histological understanding of the health and the disease process, in turn supporting the proper diagnosis of gingivitis or periodontitis.

2) Merging multiple disciplines: clinical practice, applied anatomy, and histology within a single learning module will provide practical, cognitively efficient delivery of the curriculum.

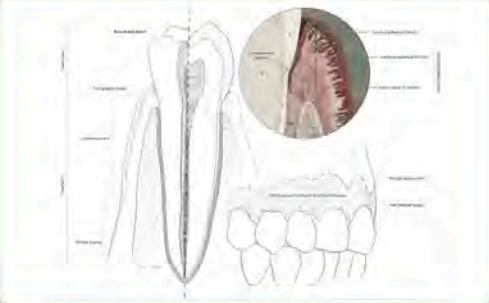

Figure 1: Learning goals illustrated in 2D, author's

Materials & Methods

Required physical features were identified based on their importance to periodontal-disease identification available in both gross and histological-level examination. Other features identified as essential for visualization in the model are: Tooth enamel, cementum, dentin; collagen fiber direction; biological width; cementoenamel junction; and mucogingival junction. The second premolar was cut on the buccolingual plane, so a distal-aspect cross section is ever present for student reference. Similarly, one-quarter of the gingiva surrounding the third molar was cut, to view the histology of the periodontium in relationship with the tooth surface. Each model was created as a separate subtool so that appropriate tactile force feedback could be programmed for each structure.

Each model was duplicated and decimated to the lowest number of triangle polygons possible while still maintaining basic form. The decimated models were then divided up to the needed resolution for polypaint and texture. At the highest subdivision level, the divided mesh was projected onto the original high-poly quad mesh to regain detail. Each subtool was taken to the lowest subdivision level and cloned for UV unwrapping. The maps were opened in Photoshop and the diffuse layer painted with schematic histological features. All assets were then brought into Autodesk 3DS max, checked, and exported as a .3DS file. the file type compatible with the Quick Haptics platform.

The models were uploaded to Sketchfab using the Sketchfab-Zbrush plug in. The course modules were created in Articulate Storyline using web-object embedding for 3D model interaction and evaluation. Due to the scope of this project, the haptics module and feedback/replay portions of the course remain in mockup phase for conceptual overview.

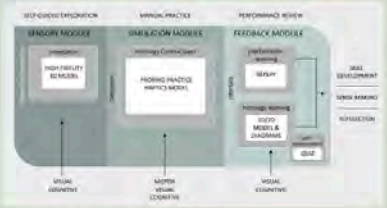

Figure 2: Polygon mesh resolution

Figure 3: Methodology for multi-modal content delivery

Figure 4: Production: Software workflow

Results

Seven anatomical models and ten instruments were created. The lowpoly version of each model component and UV maps were brought into 3D Systems Inc. OpenHaptics, QuickHaptics™ software version to test mesh/map system rendering and compatibility. A web- and LMS-based version of the learning module was made with a quiz section, glossary, and resources developed under the advisory of Dr. Ashrafi, director of the pre-doctoral periodontics department. Comprehensive committee satisfaction was reached through assessment of the models via the prototype learning module hosted online at: http://nbarto3.people.uic.edu/research/story_html5.html

Figure 5: Final model render

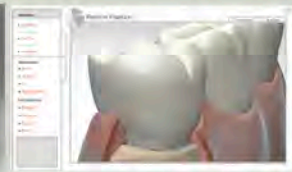

Figure 6: Learning module interface design

Discussion & Conclusions

Although simulator-based education has become prominent in research and development, technological advances do not necessarily add up to better learning outcomes. Incorporating visually-amplified models and utilizing instructional design concepts in the creation of medical simulator experiences may inspire new levels of expectation in the educational reach of simulators. In this case, the ability to explore and interact with histological features non-observable in the clinical procedure provides the opportunity for in-depth learning of the etiology of the disease. This project intends to demonstrate that a medical illustrator's contribution is equally important to that of the engineer when developing a medical simulator platform.

Acknowledgements

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Nova Hayes[1] MS, Karen Bucher[1] MA
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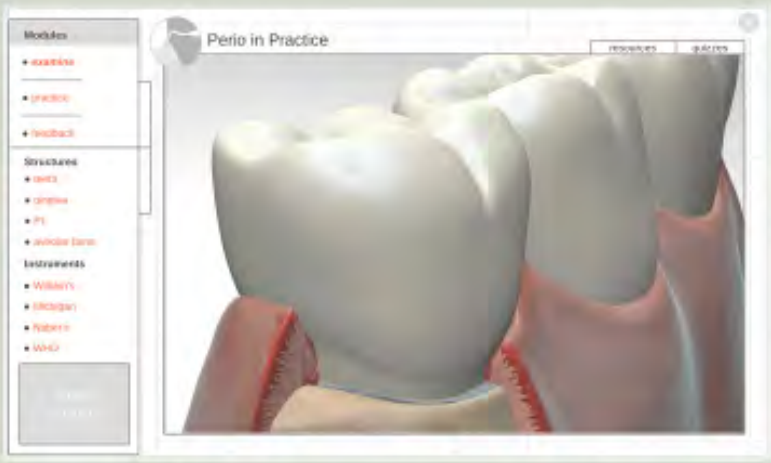
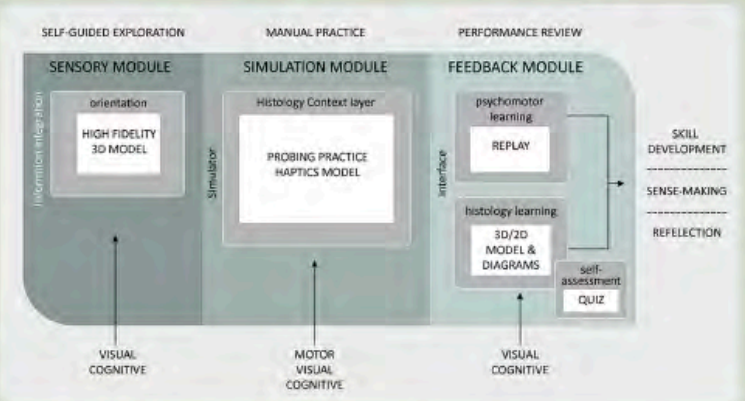


Figure 6: Learning module interface design



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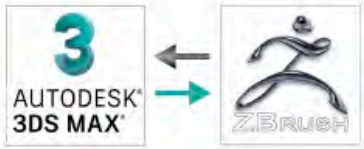

Figure 4: Production: Software workflow

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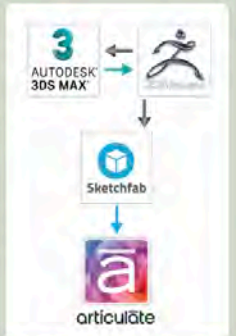

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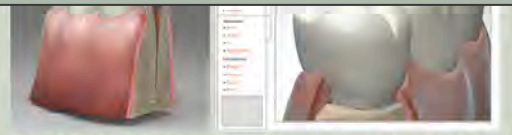

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ANTIDEPRESSANT-MINING A-Z (AMAZ)
Designing a Web-based Algorithm and Visual Language for Antidepressant Drug Selection to Educate Primary Care Practitioners

Amy Zhong M.A., Adam I. Kaplin, M.D., Ph.D., Kristen Rahn Hollinger, Ph.D., Jennifer E. Fairman, M.A., C.M.I., F.A.M.I.
The Johns Hopkins University School of Medicine

Abstract

Depression is a mental disorder that affects approximately 14.8 million American adults each year. While psychiatric professionals are essential for the management of mental health, majority of patients seek care from their primary care practitioners. The AMAZ application is designed to guide PCP users through abridged psychiatric consultations. Patient responses are entered into an algorithm and the most optimal patient-specific treatment selections are identified. The visual language introduced provides a unique approach to communicating the effect of antidepressants on key neurotransmitter systems, a concept vital to understanding how to target neurons in specific circuits and making rational antidepressant drug prescription choices.

Introduction

Between 1988-1994 and 2005-2008 use of antidepressant drugs increased by 400%[1]. In 2010, antidepressants were the second most commonly prescribed drug in the US[2]. Meanwhile, disturbing evidence shows a steady increase in suicide rates since 2005 with the US suffering nearly 43,000 deaths in 2014[3]. This phenomenon launched awareness of the increasing involvement of primary care practitioners in mental health – 80% of psychotropic drug prescriptions were made by PCPs in 2013[4] – and the evaluation of their abilities to detect depression and implement the necessary treatment. Existing treatment decision aids fail to differentiate between drugs within the same drug class, and are not helpful teaching aids useful for fast-paced work environments.

Bibliography

[1]Pratt L A, Brody D J, Gu Q. Antidepressant use in persons aged 12 and over: United States, 2005–2008. Centers for Disease Control and Prevention, [1 October 2011, Accessed via the Web, 1 Nov. 2015].
[2]IMS Institute for Healthcare Informatics (2011). The Use of Medicines in the United States: Review of 2010. [Accessed via the Web, 1 Nov. 2015].
[3]American Foundation for Suicide Prevention. "Suicide Statistics." [Accessed via the Web, 19 February 2016].
[4]Barkil-Oteo A. Collaborative Care for Depression in Primary Care: How Pychiatry Could "Troubleshoot" Current Treatments and Practice. Yale Journal of Biology and Medicine [2013, Accessed 14 March 2016].

Materials & Methods

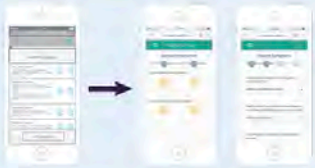
Step 1: Research & Drug Tables

Tables were created to organize data such as generic name, brand name, drug class, half life, side effect profile, side effect frequency, drug drug interactions, contraindicated patient profiles, and mechanisms of action, neurotransmitter inhibition potency levels, and key neurotransmitter systems were recorded.

Step 2: Flowcharting

Following the model of general psychiatric consultation practices, the major themes relevant to drug selection were identified to be: general information, patient medical history, family medical history, patient symptoms and patient preferences. A flowchart was created on Adobe Illustrator CC to illustrate where these major decision points of the algorithm would appear in the application. Considerations were made for the possibility of saving patient records as reference for future medical follow-ups.

Step 3: Wireframing & Application Design



Wireframes were drafted using Adobe Illustrator CC based on initial discussion of mobile web application goals and objectives. Using the wireframes as a foundation, preliminary application designs were produced.

Discussion & Conclusions

The application was accepted into the JHU I-Corps program, and we are currently working to optimize the antidepressant drug-selection algorithm and testing its validity.

Results

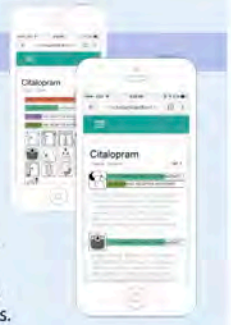
Visual Language

Side effect icons correlate with primary pharmacologic action of key mechanisms. The objective in the creation of these graphic elements were to ensure easy recognition and stylistic cohesiveness.

The visual language not only allows the user to identify which mechanisms are involved, but also how potent. This information is advantageous when considering antidepressants to avoid possible overdose. For example, if a patient is already taking a drug that increases serotonin levels, antidepressants with high 5HT transporter inhibition should be avoided. In addition, the presence of more than one mechanism per side effect indicates an increased severity of that side effect.

Algorithm Results

Using a series of practice-based scenarios provided by Dr. Kaplin, the algorithm consistently ranked majority of the ideal drug selections at the top and less ideal drug selections at the bottom. The patient preferences proved helpful in ranking similarly ranked drugs.



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for A

Amy Zhong M.A

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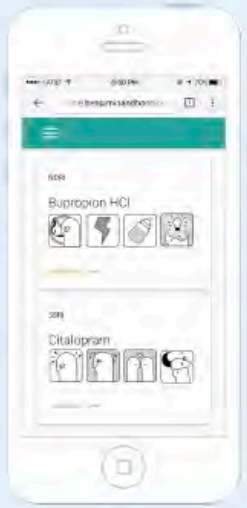

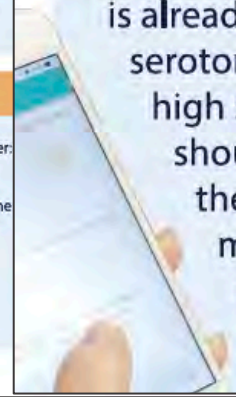

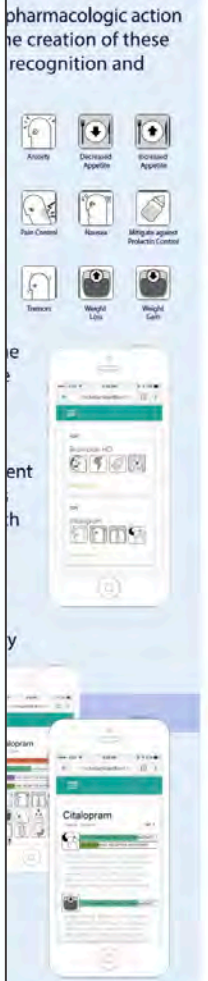

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Aesthetics

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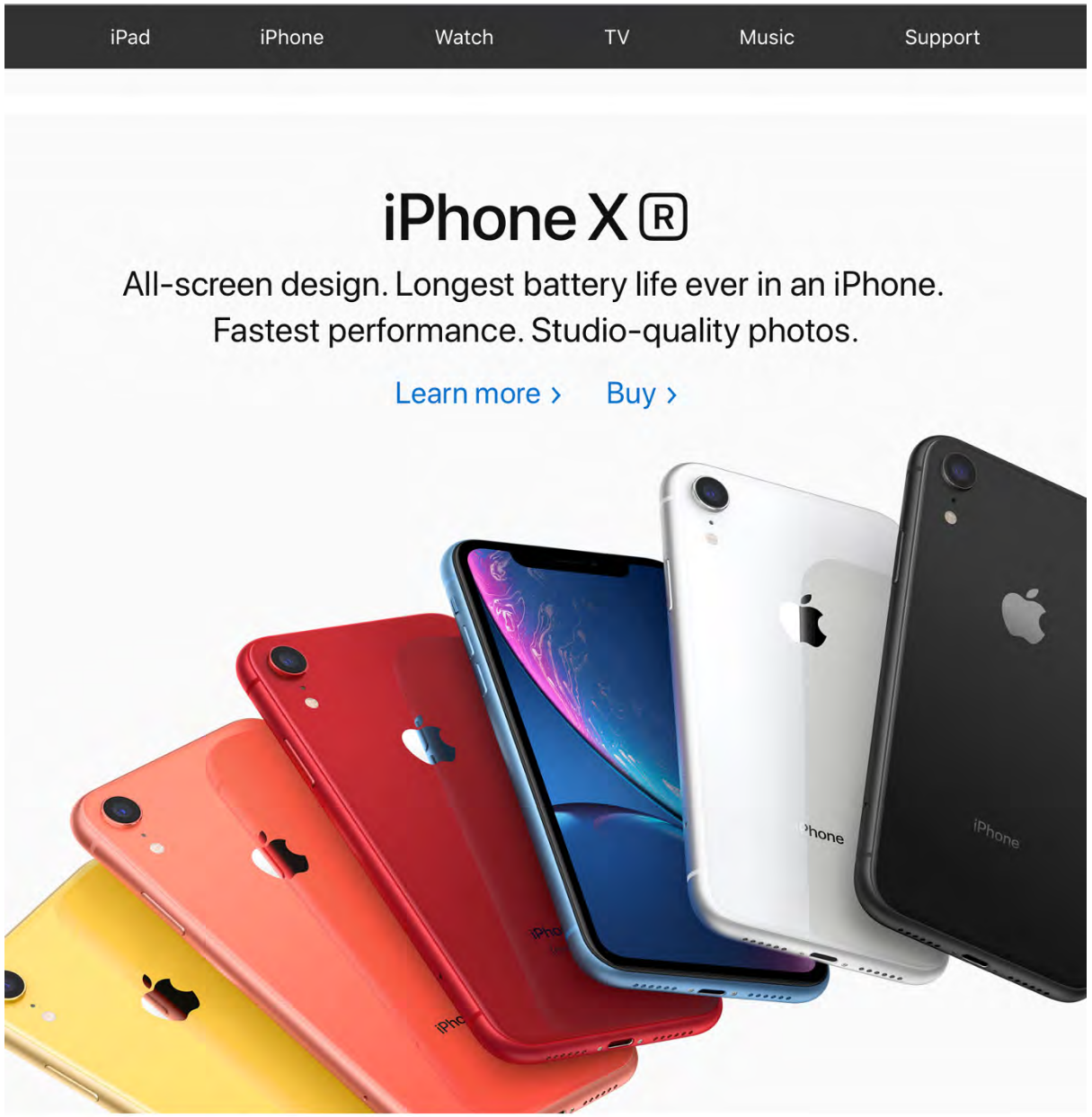

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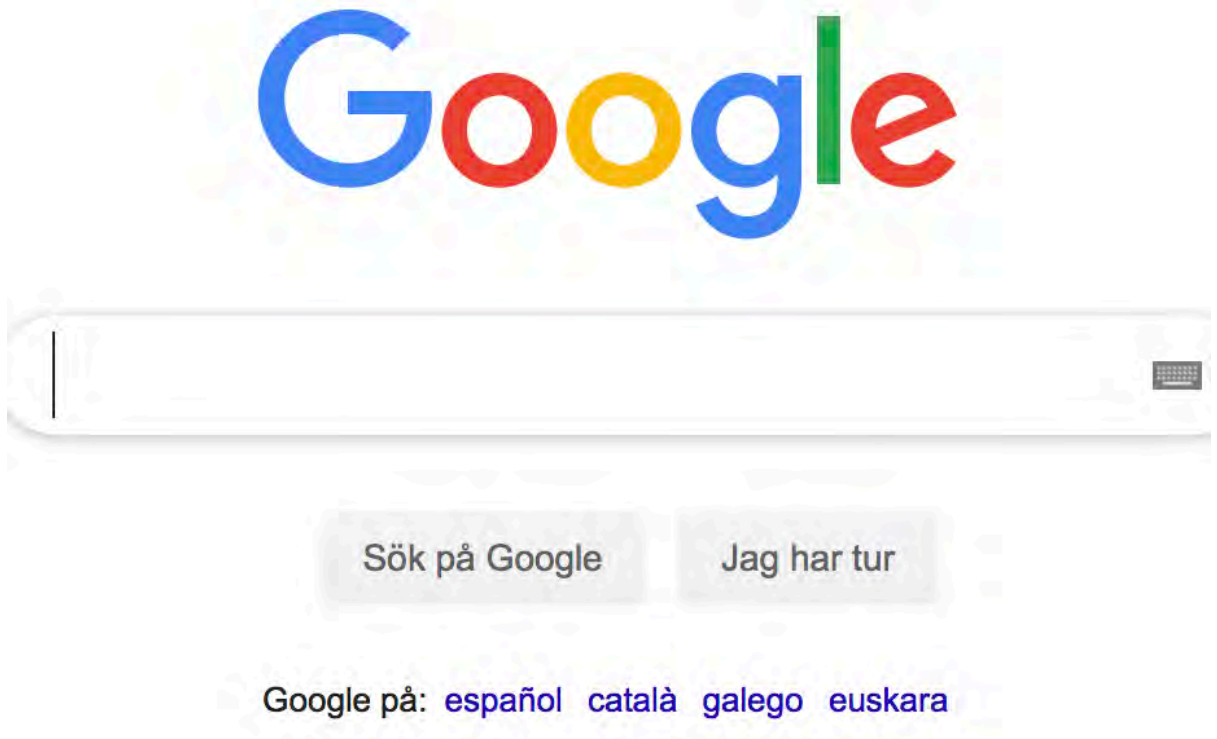

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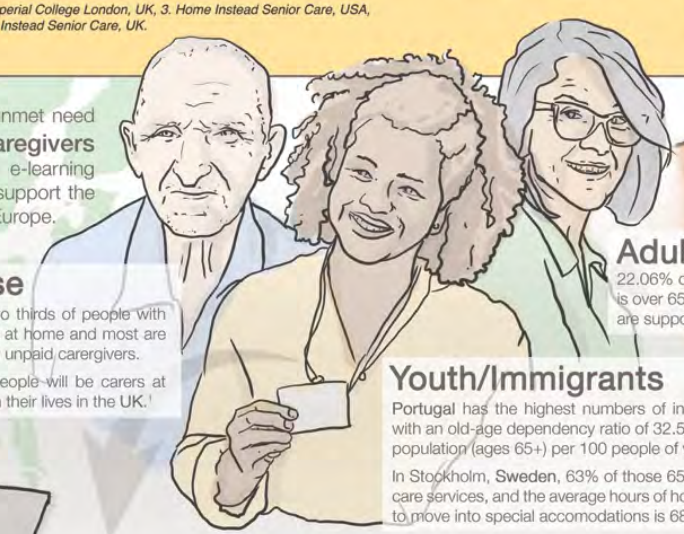
You are **85**, **frail** and might have **dementia**... **who** will take **CARE** of **you**?

Co-development of a comprehensive, open, online, carer education for Europe.

A. Lilienthal[1], E. Muir[2], L. Owen[3], L. Alksten[4], T. Brocklebank[5], M. Somai[2], H. Jansson[1], J. Höög[1], L. Middleton[2]

1. Karolinska Institutet, Sweden, 2. Imperial College London, UK, 3. Home Instead Senior Care, USA, 4. Stockholm Stad, Sweden, 5. Home Instead Senior Care, UK.

Our aim is to cover the unmet need for quality education for **caregivers** through an EIT Health e-learning training program that will support the needs of older citizens in Europe.



Spouse

In the **UK** two thirds of people with dementia live at home and most are supported by unpaid caregivers.

3 out of 5 people will be carers at some point in their lives in the UK.[1]

Adult Child

22.06% of the **German** population is over 65[4] and 2/3 of older citizens are supported by a close relative.

Youth/Immigrants

Portugal has the highest numbers of informal carers without training and with an old-age dependency ratio of 32.5, which is the ratio of the older-age population (ages 65+) per 100 people of working age (ages 15-64).[2]

In Stockholm, **Sweden**, 63% of those 65+ and living at home receive home care services, and the average hours of home care per month before needing to move into special accomodations is 68 hours![3]

Co-Development of Accessible Training

Open Online Courses via edX:

- Introduction to Caring for Older Adults
- Supporting Older Adult Personal Care & Independence Part 1 of 2
- Supporting Older Adult Personal Care & Independence Part 2 of 2,
- Age Related Diseases and Disorders
- Promotion of Healthy Ageing
- Care for Carers
- Technology and Ageing
- The Dynamics of Population Change... You are not Alone
- Nutrition in Ageing
- Caring at End of Life

Partners in CARE

Improve & Increase

- Quaity of life
- Job/relationship satisfaction
- Number of trained carers
- Recognition & employability
- Value proposition of quality care

Do you **CARE**?

What kind of carer are you?

The Spouse

Adult Child

Other Citizen

Is the work Paid? Yes / No

Type of work Full-Time / Part-Time

Scan QR code to complete poll

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Visit: **Care-campus.eu**

Poster Designer:
Anneliese Lilienthal

Comparing the Effectiveness and Engagement of Comics to 3D Animation in Teaching Advances in Nanomedicine

Angela W. Gao[1], Evelyn T. Maizels, MD, PhD, MS[1], Kevin M. Brennan, MS, CMI[1], C. Shad Thaxton, MD, PhD[2], Kaylin McMahon, PhD[2], and Christine D. Young, MA, CMI, FAMI[1]

[1]Department of Biomedical and Health Information Sciences, University of Illinois at Chicago, Chicago, IL, [2]Department of Urology, Northwestern University, Feinberg School of Medicine, Chicago, IL

Abstract

Translating new discoveries into viable therapies is dependent upon communication between scientists and medical professionals, especially in the emerging field of nanomedicine. Understanding of mechanisms on the cellular and molecular scale is commonly facilitated using 3D animation. However, this project sought to validate the knowledge transfer of complex biomedical information in nanomedicine using an alternative medium, the comic book. This medium has been effective for science communication but remains largely untested in medical education.

In order to explore the differences in knowledge gain, engagement, and preference between comics and 3D animations, a comic book about a synthetic high-density lipoprotein gold nanoparticle's apoptotic effects on lymphoma cells was created and compared to a 3D animation with identical content. Thirty-five individuals consisting of medical students, physicians, graduate students, and research scientists in the biomedical sciences were randomly shown the comic or the animation following a pretest. A posttest and preferences survey was conducted afterward. Results indicated that both the comic and animation were similarly effective at increasing knowledge about the HDLAuNP mechanism of action and had a similar level of engagement.

Background

HDL AuNP as a Potential Therapy for Lymphoma

Communication of biomedical research discoveries to healthcare professionals is crucial to the acceptance and implementation of new technologies and therapies for disease, especially in the fast-paced, emerging field of nanomedicine. One such discovery is a synthetic HDL gold nanoparticle (HDL AuNP) which is being investigated in the treatment of diffuse large B-cell lymphoma (DLBCL) (Rink et. al 2017). The HDL AuNP mimics native HDL and binds a receptor expressed on malignant B cells, scavenger receptor class B type I (SR-BI). This event blocks cholesterol transport to the B cell necessary for metabolism, leading to apoptosis. It has been experimentally shown to differentially affect malignant B cells without damaging healthy B cells, as the malignant B cells overexpress SR-BI (McMahon et. al 2017). Visually communicating advances in nanomedicine to medical professionals offers opportunities to advance understanding in translating research findings into clinical practice.

Animation and Learning Science

3D animations are a commonly used and accepted format for medical education and have been shown to be effective for communication of complex science information (Höffler & Leutner, 2007). Research in learning theory has identified that animation is an advantageous medium because it implements multimedia learning (Mayer, 2003) and key instructional design principles, such as the cognitive load theory (Sweller, Ayres, & Kalyuga, 2011). However, a major drawback of 3D animation is its high production cost and lengthy creation process, which limits its use in medical education.

Comic Books as an Educational Tool

An alternative medium which also follows the same learning theory and instructional design principles is the comic book. Comic books are also similar to animations in that they are viewed in a temporally-based manner. This makes them excellent for showing information step-wise information, such as drug mechanism of action (Jee & Anggoro, 2012). Unlike animations, comics have a relatively low production cost.

Comics have been successfully used in education for everything from increasing student interest and motivation in biology to explaining healthcare reform (Hosler & Boomer, 2011). Most research on comics and education has been performed in the K-12 setting and it has only cautiously begun to enter traditionally academic arenas such as medical education. Comic-like study tools for medical students, such as SketchyMedical (www. sketchymedical.com) and Picmonic (www.picmonic.com) have been widely used and commercially successful, and indicate a possible role for comics in medical education. This research project seeks to examine the value of a comic book format for medical student understanding of innovation in nanomedicine to determine if it may be a viable medium for education of medical students and physicians.

Materials & Methods

Animation Production

3D animation production occurred in 3 stages: script & storyboard, animatic, and animation. Storyboards were sketched out in Adobe Photoshop. An animatic, made for testing out camera motions and adjusting composition, was created with primitives in Autodesk 3ds Max. Narration was recoded and edited with Adobe Audition. The final models were rigged, animated, rendered out of 3ds Max with the Redshift render engine, composited in Adobe After Effects, and encoded in Adobe Media Encoder. This animation was created in collaboration with UIC biomedical visualization graduate student, Stephanie O'Neil.

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The final comic was also intended to teach the effect an mechanism of HDL AuNP on diffuse large B cell lymphoma, but the style and tone were quite different from that of the 3D animation.

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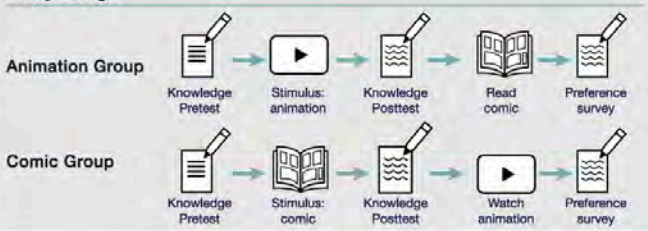

Results

Mean Pretest and Posttest Scores

	Pretest	Posttest	Difference
Comic Group (n = 17)	7.47 (57.5%)	8.47 (65.2%)	1.00 (7.7%)*
Animation Group (n = 18)	7.56 (58.1%)	9.00 (69.2%)	1.44 (11.1%)*

Scored out of 13 points total. * indicates significance via Wilcoxon signed rank test.

Response to Stimulus

	Clarity	Information Appropriateness	Engagement
Comic Group (n = 17)	5 (4.88)	5 (4.59)	5 (4.71)
Animation Group (n = 18)	4 (4.11)	5 (5.61)	5 (4.56)

Rated on a 5-point Likert scale. Median response shown, with mean in parentheses.

Learning Preference

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Bibliography

1. Rink J, Yang S, Osman C, et al. Rational Targeting of Cellular Cholesterol in Diffuse Large B-Cell Lymphoma (DLBCL) Enabled by Functional Lipoprotein Nanoparticles: A Therapeutic Strategy Dependent on Cell of Origin. Mol Pharm. 2017;14(11):4042-4051. doi:10.1021/acs.molpharmaceut.7b00710.

2. McMahon KM, Scielzo C, Angeloni NL, et al. Synthetic high-density lipoproteins as targeted monotherapy for chronic lymphocytic leukemia. Oncotarget. 2017;8(7):11219-11227. doi:10.18632/oncotarget.14494.

3. Höffler TN, Leutner D. Instructional animation versus static pictures: A meta-analysis. Learn Instr. 2007;17(6):722-738. doi:http://dx.doi.org/10.1016/j.learninstruc.2007.09.013.

4. Mayer RE. The promise of multimedia learning: using the same instructional design methods across different media. Learn Instr. 2003;13(2):125-139. doi:http://dx.doi.org/10.1016/S0959-4752(02)00016-6.

5. Sweller J, Ayres P, Kalyuga S. Cognitive Load Theory. (Spector MJ, Lajoie SP, eds.). New York, NY: Springer Science+Business; 2011. doi:10.1007/978-1-4419-8126-4.

6. Jee BD, Anggoro FK. Comic Cognition: Exploring the Potential Cognitive Impacts of Science Comics. J Cogn Educ Psychol. 2012;11(2):196-208. doi:10.1891/1945-8959.11.2.196.

7. Hosler J, Boomer KB. Are comic books an effective way to engage nonmajors in learning and appreciating science? CBE Life Sci Educ. 2011;10(3):309-317. doi:10.1187/cbe.10-07-0090.

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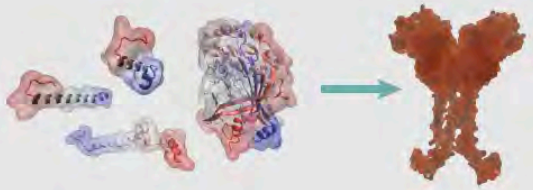

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...nt of Comics to 3D Animation in Teaching Advances in Nanomedicine

..., MS, CMI[1], C. Shad Thaxton, MD, PhD[2], Kaylin McMahon, PhD[2], and Christine D. Young, MA, CMI, FAMI[1]

...is at Chicago, Chicago, IL, [2]Department of Urology, Northwestern University, Feinberg School of Medicine, Chicago, IL

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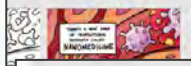

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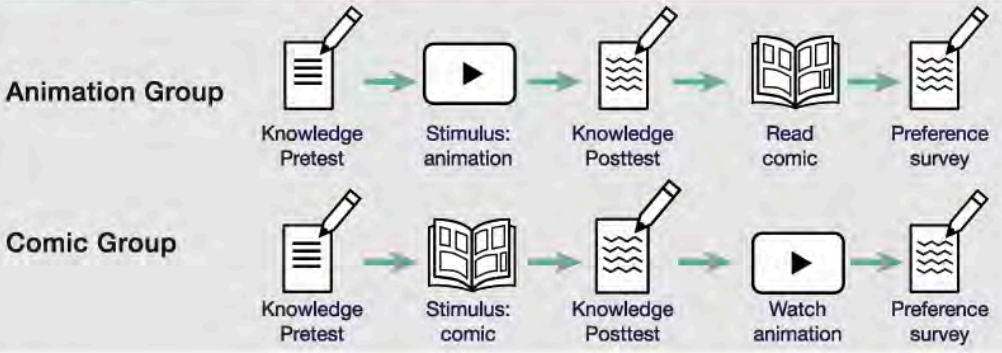
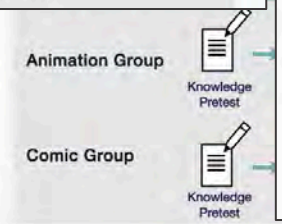


...production cost.

Comics have been successfully used in education for everything from increasing student interest and motivation in biology to explaining healthcare reform (Hosler & Boomer, 2011). Most research on comics and education has been performed in the K-12 setting and it has only cautiously begun to enter traditionally academic arenas such as medical education. Comic-like study tools for medical students, such as SketchyMedical (www. sketchymedical.com) and Picmonic (www.picmonic.com) have been widely used and commercially successful, and indicate a possible role for comics in medical education. This research project seeks to examine the value of a comic book format for medical student understanding of innovation in nanomedicine to determine if it may be a viable medium for education of medical students and physicians.



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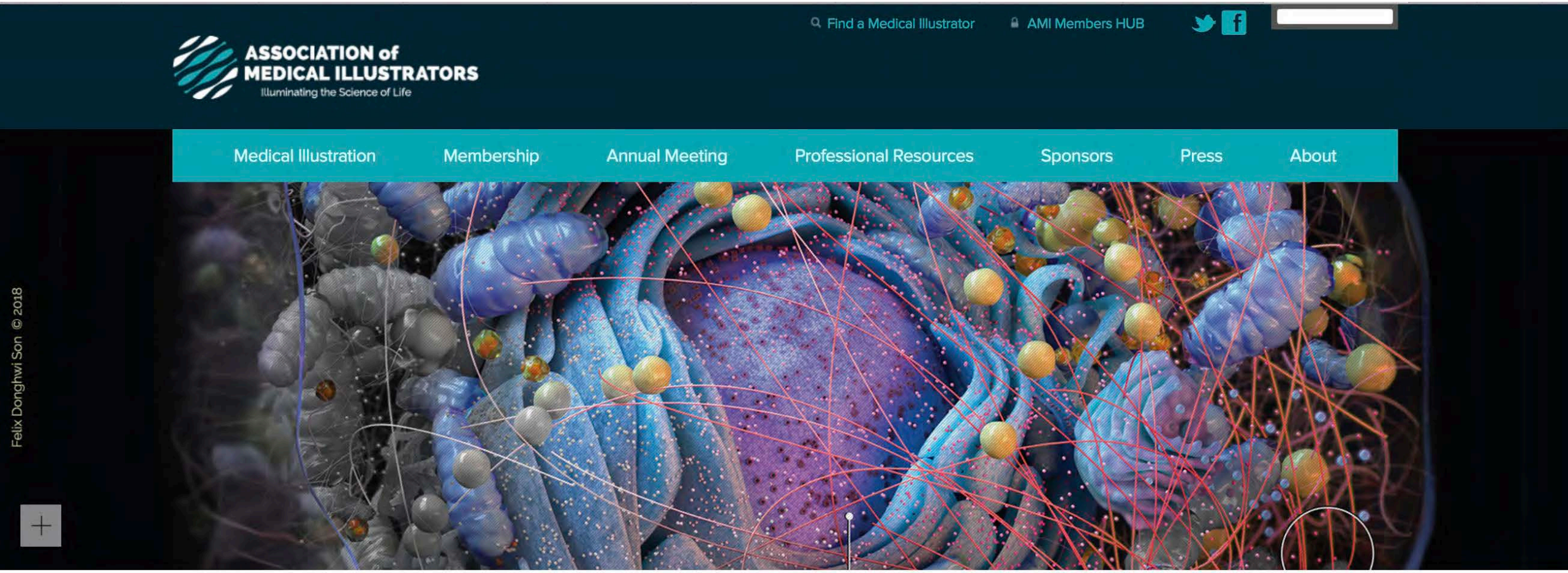

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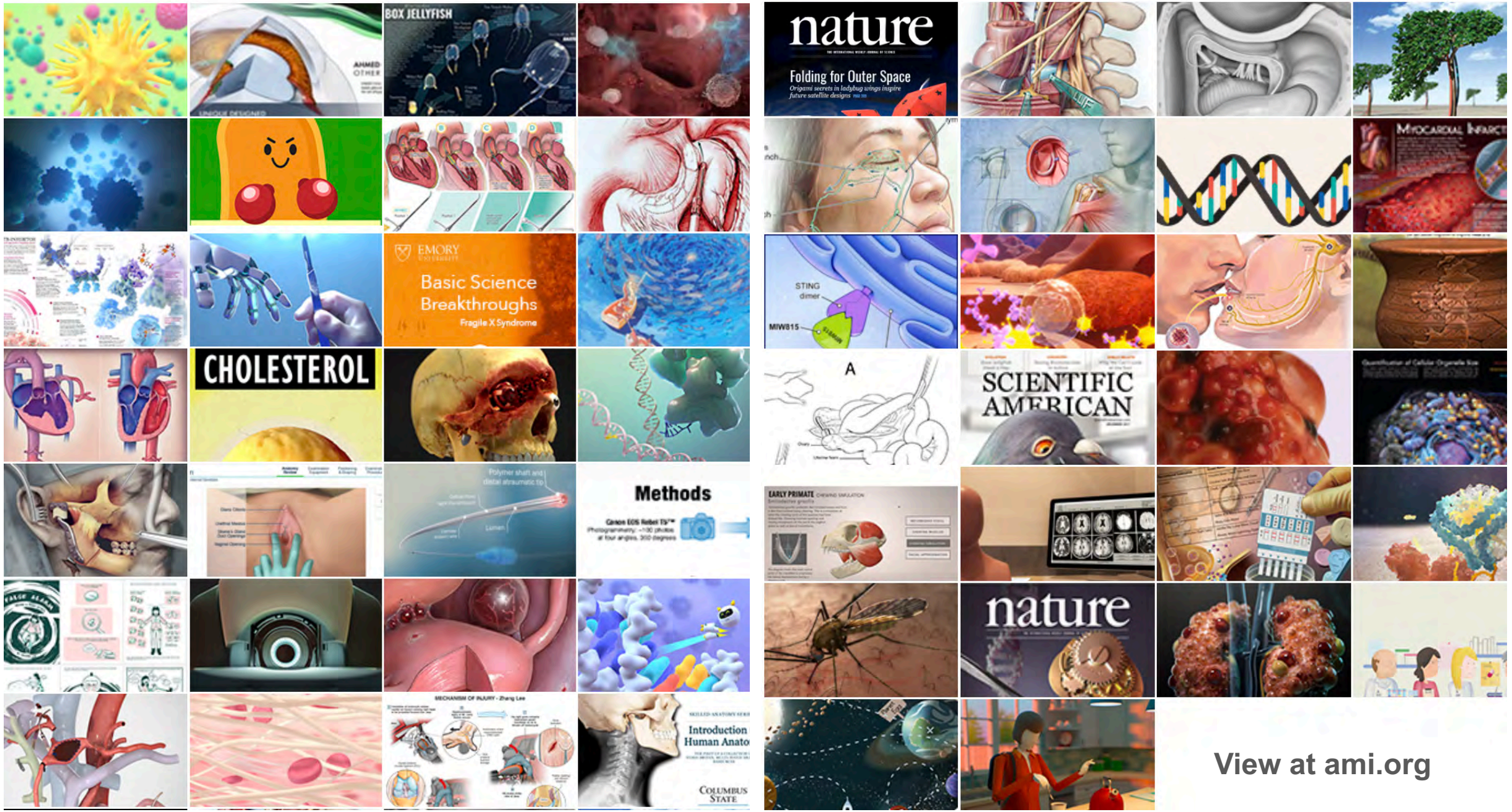
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Ages 9+
2-5 players
Competitive Education!
10-30 minutes
Ages 9+ 2-5 players
Become the safest world or the strongest world in this cut-throat learning game on vaccination, herd immunity, and disease spread!

Image Credits: Sam Bond

A 3D Haptic Virtual Model of the Neonatal Chest for Simulation of Chest Tube Insertion

Suzanne Hayes, MS, Cristian Luciano, PhD, Nishant Srinivasan, MD

University of Illinois at Chicago: College of Applied Health Sciences, Department of Bioengineering, Mixed Reality Laboratory, Department of Pediatrics, Neonatal-Perinatal Medicine

Abstract

Tactile feedback in medical learning environments can be used to provide a valuable learning experience in clinical skills, especially for procedures that are not routinely performed in a clinical setting. Neonatal chest tube insertion is a procedure that takes place under stressful circumstances in the intensive care unit. It is performed to relieve the effects of pneumothorax.

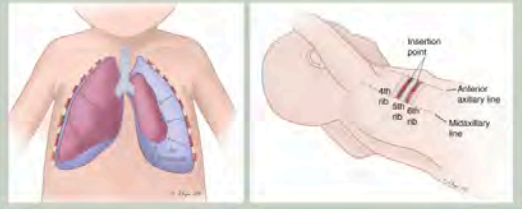
This application simulates the surgical task of puncturing the pleural sac, emulating the gradual lung inflation produced after a successful intervention.

Introduction

Competence in chest tube insertion is critical for physicians who take care of infants in the neonatal intensive care unit. Conventional training involves observing and assisting more experienced providers until the trainee gains the confidence and skills to perform by him/herself. However, situations may arise when the care provider may not have the opportunity to perfect his/her skills due to infrequent needs to perform chest tube insertion or due to patient safety concerns.

Critical complications arising from this procedure include a) broncho-pleural fistula, b) lung puncture, c) injury to intra-abdominal organs, d) penetration of medistianum, and e) injury to major vessels [1, 2].

The goal of this project was to develop a preliminary training tool for neonatal chest tube insertion using virtual reality and haptic technology. This research hypothesizes that a 3D haptic virtual model of the neonatal chest would be useful in simulating chest tube insertion for training purposes, resulting in higher psychological fidelity than the current models.



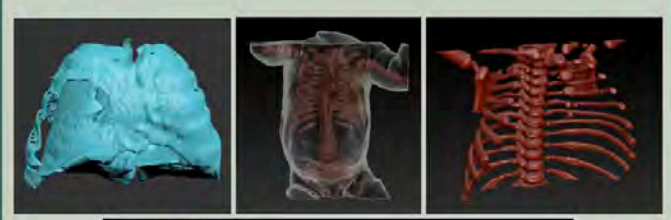
Materials & Methods

This research project created models based on real infants to be used in a virtual reality application. Segmentation of an infant chest wall was obtained using Materialize Mimics©, using data from CT and MRI scans provided by the Division of Neonatology at the University of Illinois at Chicago. The resulting 3D model of the body , ribs, and internal thoracic organs of an infant was made using Autodesk 3DS Max© and Pixologic ZBrush©. The models, textures and instruments were imported into QuickHaptics™ for evaluation.

The simulator was implemented using *LACE* Library, which is a C++ platform for virtual reality and augmented reality developed in the Mixed Reality Lab of the Bioengineering department at UIC. The graphical user interface of the application was set up so that the transparency of the baby, pleural sac, and pericardial sac could be changed. Touch callbacks were used to implement color and size changes to the lungs once the pleural sac had been breached.

Several sets of the models were made, with varying polygon counts, in order to maximize the visual appeal without overrunning the technical capabilities of the *LACE* program.

The user had the ability to change the position of the models. This allowed positioning the baby as one would in an actual clinical situation. Tactile properties of stiffness, popthrough, friction and viscosity were applied to different organs.



Results

Models were constructed using the parameters required by the haptic device. A pilot evaluation was undertaken by physicians trained in neonatal chest tube insertion. The anatomically accurate models were haptically interacted with to determine whether further development of this prototype was warranted. Interest was high in development of a higher fidelity simulator.

This research on developing a haptic application for neonatal chest tube insertion produced a VR/AR application that will eventually contribute to providing a new means of training residents.

Discussion & Conclusions

This work is unique as it was the first project at UIC Biomedical Visualization that incorporates the *LACE* application in the Bioengineering department. It uses novel technologies to develop an accurate and safe training program for neonatal chest tube insertion. Limitations are that the *LACE* library and 3d Systems haptic device are not developed enough to be able to program the application is such a way that it is completely realistic. A new graduate thesis can be procurred from this work, by developing a more powerful and technologically advanced programming application. This project may be the beginning of a unique training tool that will enhance learning in neonatal skills.

Bibliography

1. Bruschettini, M., Romantsik, O., Ramenghi, L., Zappettini, S., O'Donnell, C., & Calevo, M. (2016). Needle aspiration versus intercostal tube drainage for pneumothorax in the newborn. Cochrane Database of Systematic Reviews, (1), CD011724.
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A 3D Hapti… Si…

Suzanne …
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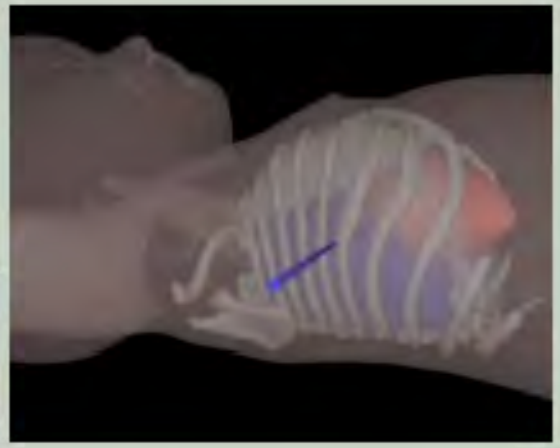

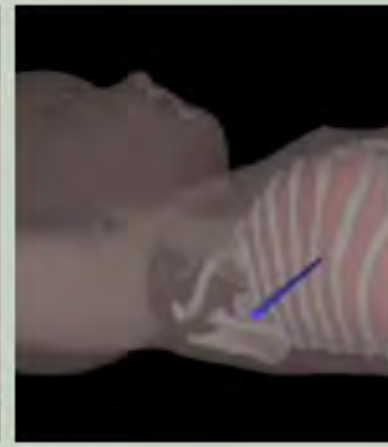

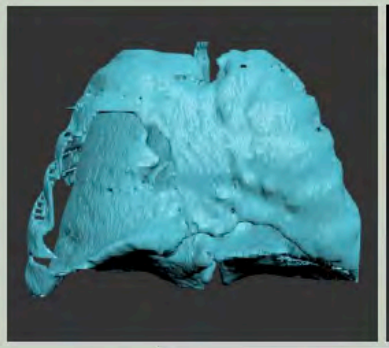

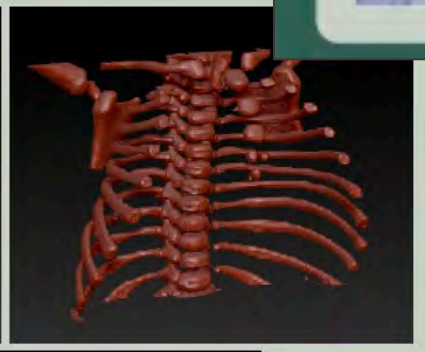

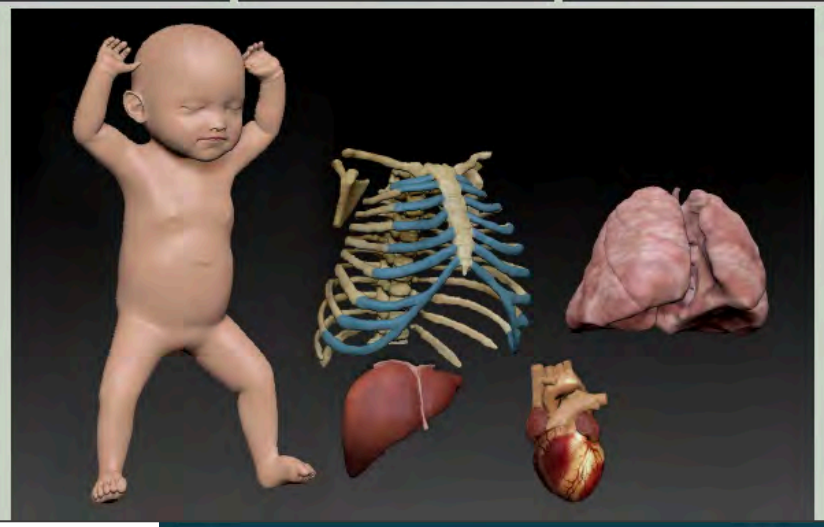

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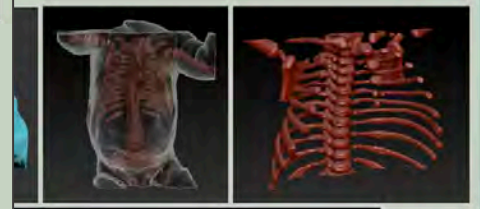

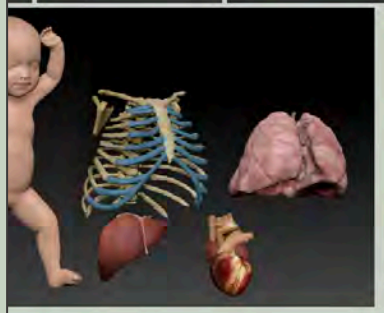

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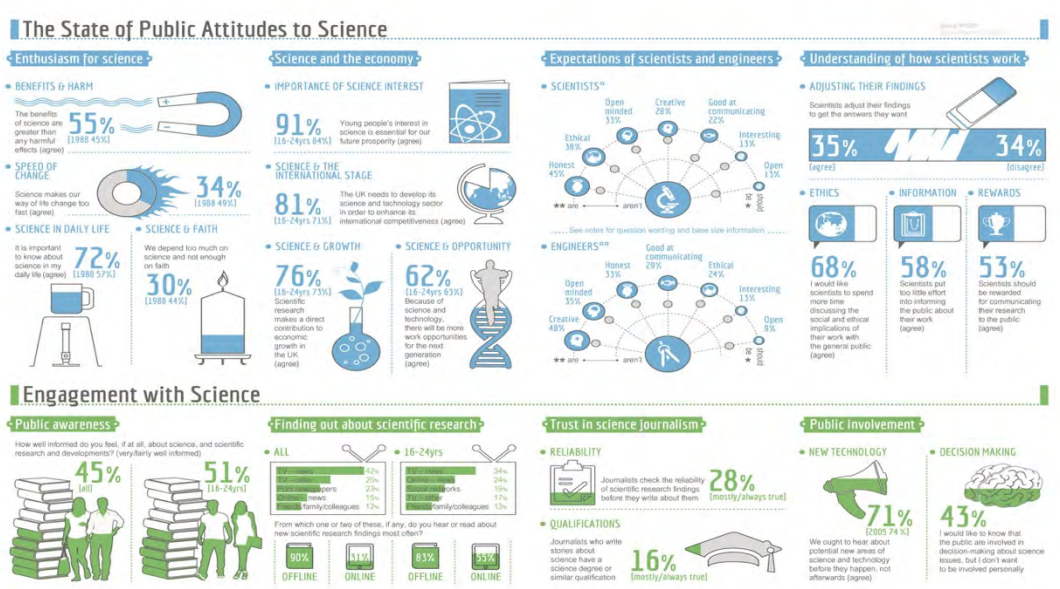

Autopsy Brain Removal Training Using Virtual Reality Simulation

Insil Choi
Johns Hopkins School of Medicine
Department of Art as Applied to Medicine

JOHNS HOPKINS SCHOOL of MEDICINE
DEPARTMENT of ART as applied to MEDICINE

ABSTRACT

Hospital autopsy is significant in diagnosing neurodegenerative disease for deceased patients. Despite its importance, training autopsy brain removal is challenging for autopsy assistants due to lack of availability of real specimens, initial hesitation to perform the procedure because of proximity to the face and limited teaching tools. To address this deficit, a virtual reality (VR) simulation was created to teach proper methodology in performing steps of the procedure. This simulation features real-time visual feedback of user performance to assist in improvement of skills during the step of opening the cranium with an oscillating saw. It also provides an immersive VR interactive experience using realistic virtual patient models, sound effects, and haptic responses.

INTRODUCTION

Autopsy Brain Removal Procedure
This procedure is performed to obtain brain specimen from deceased patients. To perform the step of opening the cranium correctly, the angulation of the saw blade should be perpendicular to the skull surface.

Limited Teaching Materials
Current teaching materials for the hospital autopsy procedure are limited to: (a) simplistic pen and ink diagrams (**fig. 1**), (b) color photographs, and (c) direct observation of deceased patients. Physical practice of the procedure is not involved in these materials.

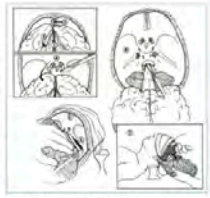

Fig. 1 Pen and ink diagrams (Hutchins, Grover M. An Introduction to Autopsy Technique. Northfield, IL: College of American Pathologists, 2005.)

Research goal
To develop a novel method of teaching the brain autopsy procedure through the use of a VR training modality. With the ability to precisely handle virtual instruments to perform actual steps on a virtual patient with real-time feedback of user actions, it provides users unlimited attempts in training. It is postulated that a virtual 3D simulation environment will augment and facilitate training of future autopsy prosectors.

Audience
Autopsy assistants, Pathology and Neuropathology residents and fellows.

MATERIALS & METHODS

1. Creation of a Patient Model from 3D Scans
To add further realism to the simulation, a 3D model of a mock patient's head and neck was captured using an Artec3D Space Spider scanner and processed using Artec3D Studio 13 Professional software (**fig. 2**).

Fig. 2 3D scanning the Patient Model to Create a Virtual Patient Model.

2. Creation of Autopsy Suite Environment
The autopsy suite environment was designed using digital-collaged images of the autopsy suite in the Johns Hopkins Hospital autopsy suite projected onto 3D walls in simulation. This adds realism and prevents the users from distraction by having unnecessary 3D objects.

Fig. 3 Two Original Photos of Autopsy Suite.

3. VR Interaction with User Interface (UI)
UI menu was designed to provide the user the freedom to start training with any step of the procedure. To allow interaction with the menu panel, a laser pointer extending from the pointer finger was added.

4. Visual, Sounds and Haptic Feedback
During the step of opening the cranium, real-time feedback is provided during simulation using a text element to aid learning experience. To add extra realism to the simulation of cutting, sound effects and cutaneous haptic feedback in the form of vibration was added to the oscillating saw activity. (**fig. 4**).

Fig.4 Oscillatin Saw.

RESULTS & DISCUSSION

1. 3D Models: Patient, Anatomy and Autopsy Environment
Several 3D models were created to complete this simulation.

Fig. 5 Patient models were created in three different dissection stages: normal, scalp and temporalis incised and reflected, and brain exposed (left to right).

Fig. 6 Completed Autopsy Suite with Patient.

RESULTS & DISCUSSION - *continued*

2. VR Interaction and Simulation During Procedural Steps

a. Choosing Step

Fig. 7 UI Interactions Using Three Buttons to Load and Hide Appropriate Patient Model for Each Step.

b. Patient Positioning

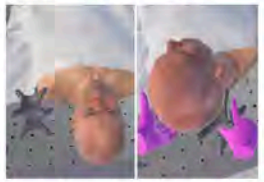

Fig. 8 Patient Positioning Step: (left) Beginning, (right) the block was placed to support patient's head prior to scalp incision.

c. Real-time Feedback in Text format
Evaluation of the angulation of the saw blade against the skull is provided using three different colors.
Green: Correct (85-95), Yellow: Acceptable (80-84 or 96-100) and Red: Incorrect (<79 or >101).

Fig. 9 Angle Feedback Provided Using Three Different Colors During Cutting Cranium.

Fig. 10 Angle Feedback Displayed on Cut Cranium.

3. Future Considerations
Simulating all other nine sections of hospital autopsy, plus prenatal and female patients may be considered. As a transition between VR training and real life autopsy service, practicing the cutting using 3D printed models are being considered.

Fig. 11 3D Printed Model of Patient's Head.

ACKNOWLEDGEMENT

Jody E. Hooper, MD, *Preceptor*
Associate Professor of Pathology, Johns Hopkins University School of Medicine
Director, Autopsy Service, Johns Hopkins Hospital
Juan R. Garcia, MA, CCA, *Department Advisor*
Associate Professor of Art as Applied to Medicine,
Johns Hopkins University School of Medicine
Director, Facial Prosthetics Clinic, Department of Art as Applied to Medicine,
Johns Hopkins University School of Medicine

Project Poster by Student Research Scholarship Recipient
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Autopsy Brain Removal Training Using Virtual Reality Simulation

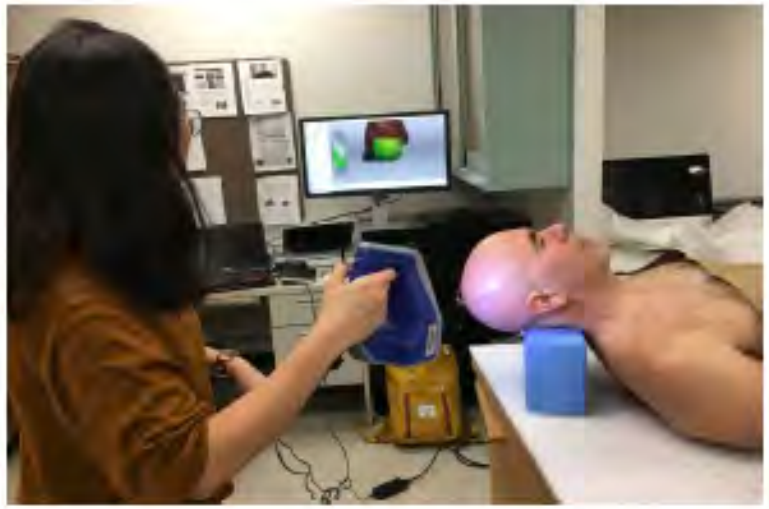

Fig. 2 3D scanning the Patient Model to Create a Virtual Patient Model.

Fig. 3 Two Original Photos of Autopsy Suite.

2. VR Interaction and Simulation During Procedural Steps

a. Choosing Step

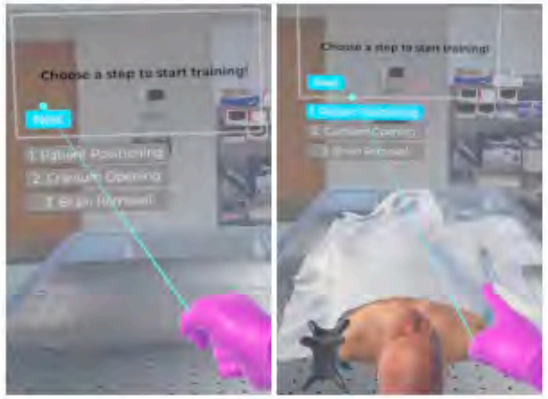

Fig. 7 UI Interactions Using Three Buttons to Load and Hide Appropriate Patient Model for Each Step.

b. Patient Positioning

Fig. 8 Patient Positioning Step: (left) Beginning, (right) the block was placed to support patient's head prior to scalp incision.

Audience
Autopsy assistants, Pathology and Neuropathology residents and fellows.

of a Patient Model
rther realism to th
of a mock patient's
tured using an A
nner and processe
3 Professional so

of Autopsy Suite En
opsy suite enviro
using digital-colla
opsy suite in the Jo
autopsy suite proje
simulation. This a
nts the users from
unnecessary 3D ob

ction with User Int
was designed to p
step of the procedu
ter extending from the pointer finger was added.

unds and Haptic Feedback
e step of opening the cranium, real-time
is provided during simulation using a text
to aid learning experience. To add extra
the simulation of cutting, sound effects and
haptic feedback in the form of vibration
d to the oscillating saw activity. (**fig. 4**).

Fig.4 Oscillatin Saw.

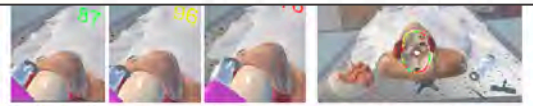

Fig. 9 Angle Feedback Provided Using Three Different Colors During Cutting Cranium.

Fig. 10 Angle Feedback Displayed on Cut Cranium.

TS & DISCUSSION

ls: Patient, Anatomy and Autopsy Environment
D models were created to complete this simulation.

3. Future Considerations

Simulating all other nine sections of hospital autopsy, plus prenatal and female patients may be considered. As a transition between VR training and real life autopsy service, practicing the cutting using 3D printed models are being considered.

Fig. 11 3D Printed Model of Patient's Head.

Fig. 5 Patient models were created in three different dissection stages: normal, scalp and temporalis incised and reflected, and brain exposed (left to right).

Fig. 6 Completed Autopsy Suite with Patient.

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A HEART IN THE HAND:
3D Printed Congenital Heart Defects Optimized for Teaching

LAURA ROY

Department of Art as Applied to Medicine, Johns Hopkins University School of Medicine

Abstract

The aim of this research was the development of 3D printed congenital heart defects (CHDs) with the primary goal of teaching parents. Patient imaging data was used to produce 3D models that were then digitally modified to emphasize key teaching points. Didactic approaches, e.g., color, flexibility, size, and labeling, were explored using a variety of 3D printing technologies. Feedback was acquired from cardiologists and cardiac surgeons to refine model designs. The result of this research was the establishment of a workflow protocol for producing didactic 3D printed cardiovascular models, specifically for CHDs.

Introduction & Purpose

Congenital heart defects (CHDs) are the #1 cause of US infant death and a leading cause of childhood death, affecting nearly 1 in 100 US births.[1] CHDs kill twice as many children as all cancers combined.[1] Parents of affected children are emotionally conflicted and often have little time to make treatment decisions.[3] Although studies suggest that parents understand cardiac anatomy and pathology better with tangible 3D visuals, few such resources exist to show CHDs.[2] For many CHDs, no physical resources exist. 3D printed CHDs are in use by physicians and are now sometimes used for teaching, but patient education has not been a primary goal of 3D print development to date.

The purpose of this research was to lay the groundwork for understanding how 3D printing can effectively be used to produce educational resources for patient education; in this case, specifically for parents of children affected by CHDs.

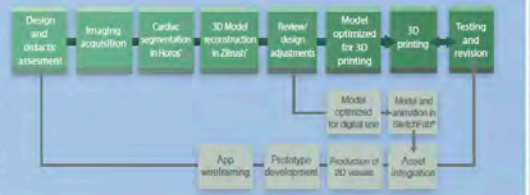
Goals

To produce and refine:

- **3D printed cardiovascular models with didactic qualities** for diverse congenital heart defects requiring differing didactic approaches for optimal teaching solutions
- **A workflow for producing additional 3D prints** of cardiovascular models with congenital heart defects
- **3D printed models of normal infant cardiac anatomy**
- **Supporting digital resources** (such as schematic illustrations and animations, and interactive digital models created from clinical data)

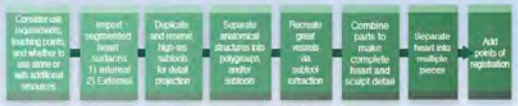
Materials & Methods

Teaching points were assessed for each CHD and potential approaches were identified in conjunction with style guidelines to apply to 3D prints and digital assets.



CT data was obtained from patients and converted to digital 3D models using Horos®. The models were refined in ZBrush®, optimized for teaching, then optimized for final use of either 3D printing or interactive digital.

3D printers ranging from the Printrbot fused filament fabrication to PolyJet Connex3 were used to explore capabilities and compare costs. After printing, post-processing techniques such as resin coating, were applied as needed.


Consider use requirements, teaching points, and whether to use alone or with additional resources
Import segmented heart surfaces 1) Internal 2) External
Duplicate and reverse high-res subtools for distal projection
Separate anatomical structures into polygroups and/or subtools
Recreate great vessels via subtool extraction
Combine parts to make complete heart and sculpt detail
Separate heart into multiple pieces
Add points of registration

Steps to prepare the digital model.

Sketchfab was used to place models into an interactive environment within a Word-press web app.

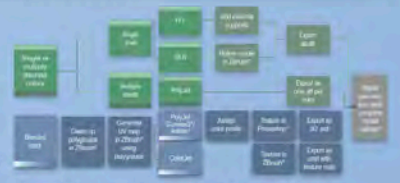
3D printing in progress on desktop Printrbot (left) and Connex3 (right)

Applying resin to protect Color Jet print

Cardiac surgeons and cardiologists provided focus group feedback throughout the design process which was used to refine designs.

Results & Discussion

The primary result of this research is a novel workflow (abbreviated at right) for production of 3D printed models optimized for teaching a lay audience—specifically parents and families of patients with CHDs. The workflow combines didactic needs assessment, segmentation, digital modeling, and 3D printing. It integrates sub-workflows for diverse printing results. It also proposes a way to integrate production of supporting digital assets into the process.



Workflow overview for producing a didactic 3D CHD print

Additional results include digital and 3D printed models of pre- and post-operative CHDs with various didactic approaches, (e.g., opacity, graphics, color, and flexibility); and a web app prototype with supporting resources.

The final set of focus group responses suggests that future models should focus on naturalistic color enhanced with didactic color; flexibility; minimal labels, and palm-sized (~2x normal infant heart).

3D printed didactic approaches

3D printing & imaging technologies are at a point where they can be used to produce teaching resources for patients. There is also potential for anatomical applications other than CHDs. Further testing should compare 3D prints to existing educational resources.

Acknowledgments

Preceptor: Duke Cameron, M.D.,
Chief of Cardiac Surgery, Johns Hopkins Hospital
Faculty Advisor: Gary Lees, M.S., CMI, FAMI,
Chair of the Department of Art as Applied to Medicine, Johns Hopkins School of Medicine
Secondary Faculty Advisor: Juan Garcia, M.A., CCA,
Associate Professor, Department of Art as Applied to Medicine, Johns Hopkins School of Medicine

Literature Cited

1. Biglino, Giovanni, Claudio Capelli, Jo Wray, et al. 3D-Manufactured Patient-Specific Models of Congenital Heart Defects for Communication in Clinical Practice: Feasibility and Acceptability. *BMJ Open*. 2015;5(4): e007165. Accessed January 10, 2016
2. CDC. Data and Statistics | Congenital Heart Defects. CDC. http://www.cdc.gov-/ncbddd/heartdefects/data.html. Published December 22, 2015. Accessed March 5, 2016.
3. Clark, S. M., and M. S. Miles. Conflicting Responses: The Experiences of Fathers of Infants Diagnfosed with Severe Congenital Heart Disease. Journal of the Society of Pediatric Nurses: JSPN 1999;4(1): 7–14. Accessed 10 January, 2016.

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3D printing & imaging technologies are at a point where they can be used to produce teaching resources for patients. There is also potential for anatomical applications other than CHDs. Further testing should compare 3D prints to existing educational resources.

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Evaluation

JMIR Publications
Journal of Medical Internet Research ISSN 1438-8871
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J Med Internet Res. 2019 Mar; 21(3): e12994. PMCID: PMC6458534
Published online 2019 Mar 28. doi: 10.2196/12994: 10.2196/12994 PMID: 30920375

Serious Gaming and Gamification Education in Health Professions: Systematic Review

Monitoring Editor: Ana Marusic

Reviewed by Vedran Katavic, Ramez Alkoudmani, and Katherine Blondon

Sarah Victoria Gentry, BMBS, MPhil,[12] Andrea Gauthier, PhD,[3] Beatrice L'Estrade Ehrstrom, MD,[4] David Wortley, FRSA,[5] Anneliese Lilienthal, MS,[4] Lorainne Tudor Car, MD, PhD,[6] Shoko Dauwels-Okutsu, PhD,[7] Charoula K Nikolaou, PhD,[8] Nabil Zary, MD, PhD,[4,9,10] James Campbell, MPH, MSc,[11] and Josip Car, MD, PhD[7]

Gentry, S. 2019.
Serious Gaming and Gamification Education in Health Professions: Systematic Review. J Med Internet Res.

Evaluation

Journal of Medical Internet Research ISSN 1438-8871
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and Gamification Education in Health Professions: ew

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Ramez Alkoudmani, and Katherine Blondon

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Results

A total of 27 RCTs and 3 cluster RCTs with 3634 participants were included. Two studies evaluated gamification interventions, and the remaining evaluated serious gaming interventions. One study reported a small statistically significant difference between serious gaming and digital education of primary care physicians in the time to control blood pressure in a subgroup of their patients already taking antihypertensive medications. There was evidence of a moderate-to-large magnitude of effect from five studies evaluating individually delivered interventions for objectively measured knowledge compared with traditional learning. There was also evidence of a small-to-large magnitude of effect from 10 studies for improved skills compared with traditional learning. Two and four studies suggested equivalence between interventions and controls for knowledge and skills, respectively. Evidence suggested that serious gaming was at least as effective as other digital education modalities for these outcomes. There was insufficient evidence to conclude whether one type of serious gaming/gamification intervention is more effective than any other. There was limited evidence for the effects of serious gaming/gamification on professional attitudes. Serious gaming/gamification may improve satisfaction, but the evidence was limited. Evidence was of low or very low quality for all outcomes. Quality of evidence was downgraded due to the imprecision, inconsistency, and limitations of the study.

Conclusions

Serious gaming/gamification appears to be at least as effective as controls, and in many studies, more effective for improving knowledge, skills, and satisfaction. However, the available evidence is mostly of low quality and calls for further rigorous, theory-driven research.

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Future Research

Serious gaming has the potential to contribute to the field of health professions education, but given that most studies to date are of low quality and carried out in high-income countries, future research should seek to use an RCT or cRCT design following a published protocol; evaluate interventions with a robust theoretical underpinning; be adequately powered; involve participants from low- and middle-income countries; appropriately randomize participants and blind outcome assessors, where possible; use validated outcome-assessment tools, facilitating comparability between interventions and studies; compare both serious gaming and gamification interventions with each other and with controls (other types of digital health education or traditional learning); and assess patient outcomes, participant behavior, attitudes, economic outcomes of education, and adverse events.

Serious Gaming and Gamification Education in Health Professions: Systematic Review. J Med Internet Res.

eHealth Media Production (Simplified)

User

Goal

Mapping / Storyboarding of Activities

Development & Iteration

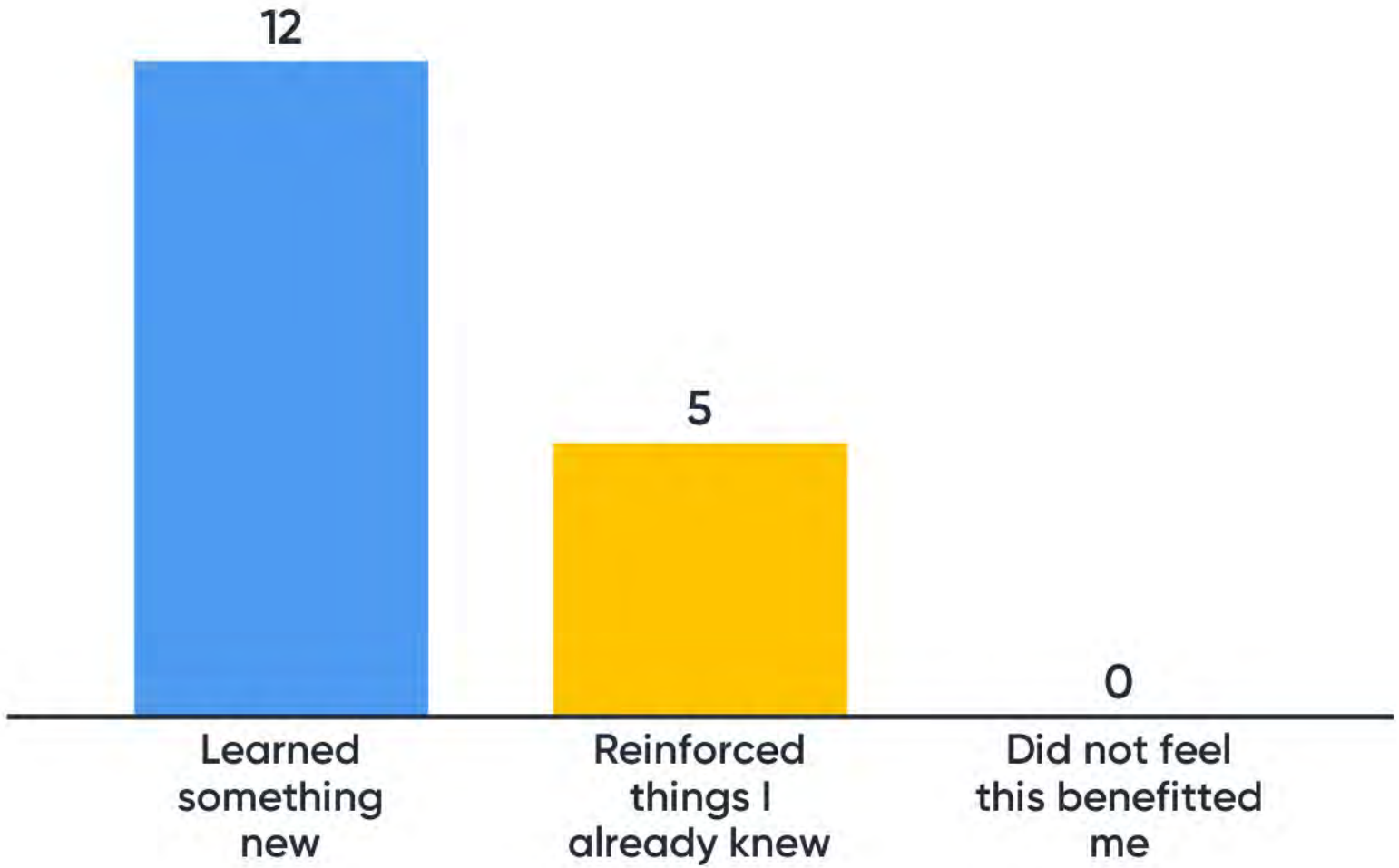
Evaluation

Objective:

To understand the complex multidisciplinary factors possibly impacting attention and engagement in multimedia so that you can begin to discuss and apply…

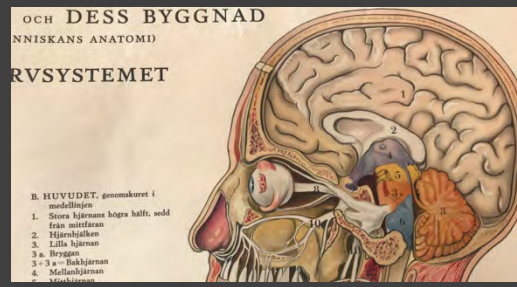
Evaluation: I feel like I...

Mentimeter



17

Peering into…
transdisciplinary intersections that impact learner experiences of eHealth multimedia



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16 July 2019 | IT & Health Bridging the Gap
eHealth Eurocampus | Barcelona | UPC Campus Nord

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Science Communication Experiential Model (SCEM) Canvas

Anneliese Lilienthal, MS, CMI, FAMI
Karolinska Institutet, Unit for Bioentrepreneurship
Anneliese.Lilienthal@ki.se

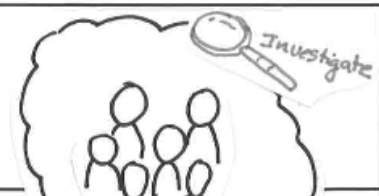
Audience

① Who are they?
Peers, Publisher, Public, Investors

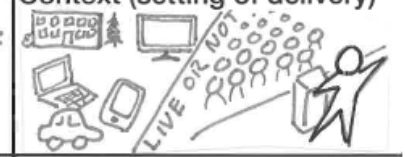
② What do they know?
- Cognitive load
- Color Blindness
- Language

③ What do they Expect?

NICHE ⟵ ⟶ GLOBAL



Context (setting of delivery)



Message

① Who is my Audience?
② Tell a story
SCALE — where do you need to start?

Cosmos
1. Problem
2. Solution
3. Why do I care?
4. Action
WIDE } Focus
How do you meet their NEEDS
What can your audience DO
Subatomic

KEYWORDS
1. 2. 3.
← Avoid long compound words
← Keep it short!

TAKE HOME MESSAGE:
This is the problem _____.
It matters to you because _____.
We did this _____ to address it.
Now we need you to _____.

Title
: 2 Parts
Declaritory
Inquisitive? | Imperative OR
Does the Story fall apart?
YES → KEEP
NO → CUT
Methods: Is this your story?

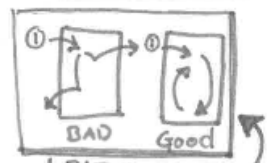
VISUAL DESIGN

- Typography
- Contrast
- Heirarchy
- Alignment
- Grid
- Negative Space
- Emotion
- Unexpected!
- Flow
- Consistency
- Layering
- Movement
- Weight
- Color (Saturation)
- Metaphore
- Tension too close

Less is MORE | Keep it Simple | Show Don't Tell

① Attract Attention
title | Figure | Color

② Keep Attention
Flow + Design



USE ICONS to help readers understand

CREDIBLE?
- No Chart Junk!
- Consistency rather than variation
- Don't Stretch or Squish!
- Give Credit/site CC

YOU

WHO ARE YOU?

ASK others about their WORK ∞ Link to Yours

Channels

ASK
- What Space
- Where
- When
- How Long

FACE 2 FACE
Sometimes YOU are the channel
Conference | Workshop | Mingle
Speed Date | Elevator | Lunch

PRINT Newspaper | Journal | Poster | Magazine | Roll-up

DIGITAL MEDIA
Podcast | Radio | YouTube | Blog | Social Media | Web

Your Brand

Contact Info + Photo

Always include →
QR code
Looks like You

Let's keep in touch...
email | cards
Phone | Prints
Skype | web

Costs

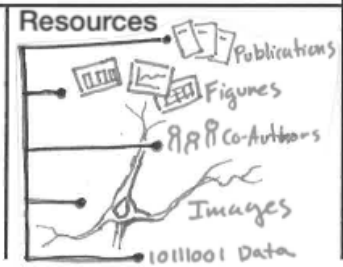
TIME
- Sleep
- other Priorities

BUDGET
- copy editing
- writing
- Design
- Graphics/ Illustration

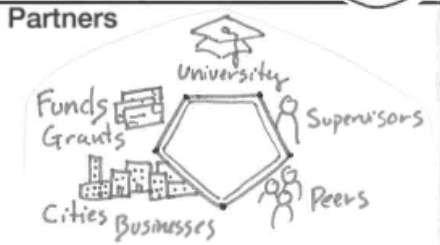
Revenue (Value)

Impressions
Views
Likes
CHANGE
Policy
Discussion
Behavior
Practice

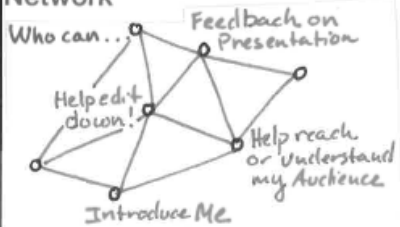
Resources



Partners



Network



Resources

1. **Software:** MS Office, Draw.io, Google Draw & Adobe Creative Cloud (Adobe photoshop/illustrator, Aftereffects, InDesign, PremierPro), Affinity Designer, Procreate.

2. **Tutorials**
   - Visualization SPARK Course
     https://www.pictureasportal.com/ (By medical Illustrators I know)

3. **Open Educational Resources**
   - Somersault1824 https://www.somersault1824.com

4. **Molecular**
   - Molecular Flipbook http://molecularflipbook.org
   - Clarafi https://clarafi.com
   - USCF Chimera

5. **Infographics**
   - https://dribbble.com/about
   - http://hitconsultant.net/2012/12/26/the-20-most-insightful-healthcare-technology-infographics-of-2012/
   - https://piktochart.com
   - https://www.easel.ly
   - https://venngage.com
   - https://www.canva.com/create/infographics/

Karolinska Institutet

Resources

7. **Data Visualization**
   - Circos – genomic data illustration http://circos.ca/intro/genomic_data/
   - **"Visualizing multidimensional cancer genomics data"** http://www.genomemedicine.com/content/5/1/9
   - Tableau https://public.tableau.com/s/gallery
   - IBM advanced visualization http://www-01.ibm.com/software/analytics/many-eyes/ http://www.ibm.com/analytics/us/en/technology/advanced-analytics/index.html
   - Broad Institute – Visualization software http://www.broadinstitute.org/scientific-community/software?criteria=Visualization
   - Visual.ly https://visual.ly
   - Periodic Table of Visualization http://www.visual-literacy.org/periodic_table/periodic_table.html#
   - http://www.creativebloq.com/design-tools/data-visualization-712402
   - https://visualisingadvocacy.org/resources/visualisationtools
   - http://www.chartjs.org
   - http://www.healthdata.org/results/data-visualizations
8. **Free icon sets:**
   - http://www.creativebloq.com/web-design/free-icon-sets-10134829
   - Don't forget to check if you can use (who owns) the visuals you want in your work
9. **Copyright**
   - Creative Commons Licences https://creativecommons.org
   - Reverse image search http://www.tineye.com
7. **Associations**
   - **AMI.org** Association of Medical Illustrators can do a search of members https://ami.org
   - AEIMS - Association Européenne des Illustrateurs Médicaux et Scientifiques http://www.aeims.eu

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Resources

8. **Imaging Data, Footage & Viewers etc.**
    - Osirix
    - 3D Slicer
    - Garden Gnome Software
    - Fovia HDVR
    - MIMICS
    - Konica Minolta VIVID laser and DI3D™ V5 ShapeShot cameras
    - Polyworks
    - Horos
    - GoPro
    - Autopano video
    - Autopano giga
    - PluralEyes3
9. **Interactive**
    - Verge3D
    - Unity
    - Artec3D Space Spider
    - Artec3D Studio 13 Professional
    - HTML5, CSS Javascript
    - C#
    - Sketchfab
    - Articulate
    - Quick Haptics
    - LACE Library (C++ for VR)
    - Adobe Captivate
    - WireFusion
    - LEAP Motion

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Resources

10. 3D

- Blender
- MakeHuman
- 3D Studio Max
- Mudbox
- Sculptris
- matlab
- Cinema 4D
- Zbrush
- Poser
- Molecular Maya
- NeuronBuild
- Autodesk Maya

11. Printing

- Printrbot fused □lament fabrication to PolyJet Connex3

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